Appendix F
Hydrology and Water Quality Studies

PRELIMINARY DRAINAGE REPORT

IN SUPPORT OF

GREAT SCOTT TREE SERVICE IMPROVEMENTS

20865 CAÑADA ROAD
LAKE FOREST, CA 92630

APN: 610-301-20, 610-301-07

Prepared for:
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June 17th, 2021

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SECTION 1 – INTRODUCTION

1.1 BACKGROUND

The Project Site is 7.36 acres and is located within the City of Lake Forest, CA, at the southwest corner of Dimension Drive and Linear Lane. It is bound by existing light industrial development on the north and south. Existing Serrano Creek (Orange County Public Works Facility F19 per the OCFCD Drainage Facilities Map) runs east-west, through the length of the Project Site. In existing conditions, runoff from the Project Site sheet flows directly into Serrano Creek.

The Project site is currently zoned for a combination of A-1 agricultural and M-1 light industrial uses. There is one residential structure (with pool and landscaped yard and multiple livestock barn/pens and storage structures.

The Project Site is within FEMA flood zone AE and X per the Natural Hazard Disclosure Report prepared for the property by First American. A LOMR was recently filed ((LOMR 17-09-1011P, effective date 7/16/18) for the segment of Serrano Creek within the property which lowered the elevation of the regulatory floodway by several feet. The Creek portion of the site remains within Zone AE; the upper portion of the site within the proposed improvement area is in Zone X.

Glenn Lukos Associates prepared a Jurisdiction Limits report for the portion of Serrano Creek which runs through the site and found that The limits of CDFW jurisdiction extend to the top of the Serrano Creek bank, or to edge of the canopy of associated riparian vegetation that is rooted at the top of bank or below top of bank and that the limits of Corps jurisdiction is located at the the Ordinary High Water Mark (OHWM), which coincides with the top of bank.

Soil Type D (Per NRCS Soil Survey), Serrano Creek runs through the Site and is susceptible to erosion. Soils are primarily Sandy Loam and Sorrento Loam along the top and upper banks along Serrano Creek and with Riverwash (sandy gravelly alluvium) located along the bottom of the Creek.

See Appendix A for Encumbrance Map, NRCS Soil Survey, Natural Hazard Disclosure Report, FEMA Flood Zone Map, OCFCD Drainage Facilities Map, and Glenn Lukos Associates Report.

1.2 EXISTING AND PROPOSED CONDITIONS

In existing condition, the majority of the Project site generally drains northwest and sheet flows into Serrano Creek. A small portion of the site is on the opposite side of Serrano Creek and sheets flows south, directly into the Creek. Other than off-site flows within Serrano Creek, the site does not receive run-on from adjacent properties. The assumption was confirmed by visual observations during a field visit on February 7, 2020. On-site soils are highly compacted and there are no catch basins, area drains, underground storm drain conduits, and no locations of concentrated storm water outlets into Serrano Creek. The Project intends to maintain existing grades and drainage patterns across the site.

The existing residential structure and one storage structure will remain in the proposed condition. Gravel will be laid over a large portion of the site to stabilize the existing native surface and allow for all-weather access and parking for Great Scott Tree Service vehicles. The existing residential structure will be converted into office space for Great Scott Tree Service, Inc., and a minimum parking lot constructed for office employee parking. An approximate 7,050 sf concrete pad will be poured for landscape operations (mulching and drying of vegetative materials gathered from tree service projects. The concrete pad will be at grade, and the runoff from the concrete pad will sheet flow towards the proposed water quality bioswale that borders the proposed development.

In the improved condition flows will be directed into a bio-swale that runs along the perimeter of the project site (closest to Serrano Creek). The bio-swale will be utilized for further cleansing of the storm flows with particular focus on removal of organics through surface contact. The bio-swale will be underlain with an underdrain. The underdrain from each bio-swale will pipe flow and then discharge into a detention basin at the southwest of the project. The detention based was sized to capture peak storm flows and attenuate the Q_{100} by a minimum of 38%. After attenuation the flows will exit the basin through an underdrain that will discharge into the nearby Serrano Creek. A schematic of the drainage system can be seen in Appendix B.

SECTION 2 – HYDROLOGY

2.1 EXISTING CONDITIONS HYDROLOGY ANALYSIS

The site is divided into three distinct drainage areas, each sheet flowing directly into Serrano Creek. Serrano Creek has headwaters in the Santa Ana Mountains and is a channelized, natural water course as it flows southwest, through the mountains and urbanized areas of the City of Lake Forest. Serrano Creek confluences with La Cañada Channel and San Diego Creek prior to flowing into the estuaries of Upper and Lower Newport Bay, and the Pacific Ocean.

Existing and proposed conditions on the site are anticipated to result in similar Stormwater runoff rates due to minimal proposed grading, improvements or changes to impervious. Existing site imperviousness is approximately 26%. Proposed imperviousness will be increased to due to the addition of required parking stall and a concrete pad for landscape operations along with modeling of the proposed gravel areas as paved areas to be conservative.

The existing site was separated into onsite and offsite flows that currently drain into Serrano Creek. All offsite flows are captured by inlets which are routed under the site and expelled into the creek. Remaining flows onsite primarily sheet flow into the creek. For reference see the Existing Hydrology Map in Appendix B. All existing flows were measured and compared at the most downstream collection point. Results have been compared with the proposed conditions and are summarized in Section 2.3.

2.2 PROPOSED CONDITIONS HYDROLOGY ANALYSIS

The proposed condition of the site is also divided into three distinct drainage areas, which can be seen on the Proposed Hydrology Map in Appendix B. In the proposed condition, all offsite flows will still be captured by inlets which then outlet into Serrano Creek. Proposed imperviousness will be increased to approximately 31% due to the addition of required parking stall, modeling of the proposed gravel areas as paved areas and a concrete pad for landscape operations. As part of the proposed improvements, the Project will place approximately 40,800 square feet of gravel over native soil for vehicle parking and access. The onsite flows will now be rerouted to drain from the gravel to proposed vegetated swales located along the westerly edge of the site. The swales will allow for water treatment before entering underground storm drain which then outlets into a proposed detention basin located at the southwest of the site. During peak flows this detention basin will fill and discharge flow through a standpipe and underdrain system that will convey flows to Serrano Creek.

The site has been modeled in AES and simulated using the 2-year, 25-year, and 100-year storm events. The results can be seen in the next section. Due to erosion issues along Serrano Creek, future developments have been requested to reduce the site runoff into the creek by 38% through detention. The onsite detention basin has been designed to capture peak flows from onsite only, and reduce this flow by the minimum 38% required. Current design has mitigated onsite flows for a 100-year storm event from 10.83 cfs to 5.62 cfs as shown in the flood routing calculations found in Appendix C and summarized below in the Mitigated Flow Summary Table. This results in a peak flow reduction of 48%.

2-year event hydrologic calculations provided in the Conceptual WQMP (separate report) show that the project will not result in a Hydrologic Condition of Concern. Refer to Conceptual WQMP (separate report).

Additional detailed drainage analysis will be provided in the final drainage report.

2.3 CONCLUSION

The site was divided into distinct drainage areas for the existing condition and for the proposed condition. The drainage areas were determined for each condition using information gathered from contours, built and proposed infrastructure, and site visit conducted on February 7th, 2020. A 300 foot flow path limit was also imposed in accordance with the Orange County Hydrology Manual. The existing and proposed exhibits can be seen in Appendix B. The site was modeled in AES and simulated using the 2-year, 25-year, and 100-year storm event. Serrano Creek flows were measured and compared at the most downstream collection point. A summary of results can be seen below for on-site unmitigated and mitigated flows.

Unmitigated Flow Summary Table (no detention basin in analysis)

	Q_2 (cfs)	Q_{25} (cfs)	Q_{100} (cfs)	T_{c2} (min)	T_{c25} (min)	T_{c100} (min)
Existing Condition	3.57	8.32	10.83	11.23	10.67	10.48
Proposed Condition	3.38	7.65	9.92	12.04	11.13	10.82

Mitigated Flow Summary Table (with detention basin in analysis)

	Q_{100} (cfs)	Percent Reduction
Proposed Condition	5.62	48.1%

As seen in the Mitigated Flow Summary Table above, the amount of runoff entering Serrano Creek during the proposed condition does not exceed that of the existing condition. This is due to the detention basin within the project area. Additionally, the difference in time of concentration between the existing and proposed condition can be considered negligible.

APPENDIX A

Previous Studies and Reports

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF LAKE FOREST IN THE COUNTY OF ORANGE, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

PARCEL 1:

PARCEL A OF PARCEL MAP NO. 86–133, IN THE CITY OF LAKE FOREST, COUNTY OF ORANGE, STATE OF CALIFORNIA, AS PER MAP ON FILE IN BOOK 225 PAGES 7 TO 13 INCLUSIVE OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

EXCEPT ONE–HALF OF ALL MINERALS, OIL, AND/OR ASPHALTUM OF EVERY KIND OR CHARACTER IN OR UNDER SAID PROPERTY, AND ONE–HALF OF EVERY MINERAL OR OIL RIGHT THEREIN, THEREUNTO AND THEREUNDER, AS EXCEPTED IN THE DEED FROM THE WHITING COMPANY TO BENNIE W. OSTERMAN AND CYNTHIA A. OSTERMAN, RECORDED APRIL 30, 1928, IN BOOK 153 PAGE 320 OF OFFICIAL RECORDS.

PARCEL 2:

PARCEL A: (FEE PARCEL)

THAT PORTION OF LOT(S) F OF TRACT NO. 695, IN THE CITY OF LAKE FOREST, COUNTY OF ORANGE, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 25 PAGE(S) 1 OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT 615.77 FEET NORTH 23°03'40" WEST FROM THE MOST WESTERLY CORNER OF LOT G OF TRACT NO. 695; THENCE NORTH 53°25'30" EAST 160.00 FEET; THENCE NORTH 36°34'30" WEST 167.00 FEET; THENCE SOUTH 56°25'30" WEST 60.00 FEET; THENCE SOUTH 15°36'45" WEST 135.57 FEET; THENCE SOUTH 46°14'30" EAST 95.00 FEET TO THE POINT OF BEGINNING.

EXCEPT THEREFROM ONE–HALF OF ALL MINERALS, OILS AND/OR ASPHALTUM OF EVERY KIND OR CHARACTER IN OR UNDER SAID PROPERTY, AND ONE–HALF OF EVERY MINERAL OR OIL RIGHT THEREIN, THEREUNTO AND THEREUNDER, AND THE RIGHTS AND EASEMENTS IN CONNECTION WITH SAID SUBSTANCES, AS RESERVED BY THE WHITING COMPANY IN THE DEED RECORDED IN BOOK 153 PAGE 320 OF OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID ORANGE COUNTY.

ALSO EXCEPTING WATER AND WATER RIGHTS AS RESERVED BY THE WHITING COMPANY, IN DEED RECORDED IN BOOK 153 PAGE 320 OF OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID ORANGE COUNTY.

PARCEL B: (FEE PARCEL)

THAT PORTION OF LOT(S) F OF TRACT NO. 695, IN THE CITY OF LAKE FOREST, COUNTY OF ORANGE, STATE OF CALIFORNIA, ACCORDING TO THE MAP FILED IN BOOK 25 PAGE(S) 1 OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY BEING ALSO SHOWN AS A PORTION OF A REMAINDER OF PARCEL OF TRACT NO. 11397, ACCORDING TO THE MAP FILED IN BOOK 502 PAGES 44 THROUGH 47 INCLUSIVE OF MISCELLANEOUS MAPS, RECORDS OF ORANGE COUNTY, DESCRIBED AS FOLLOWS:

BEGINNING AT THE MOST EASTERLY CORNER OF THE LAND DESCRIBED IN THE DEED TO RALSTON ANDERSON AND MAXINE E. ANDERSON, RECORDED IN BOOK 2474 PAGE 461, OFFICIAL RECORDS OF SAID ORANGE COUNTY; THENCE NORTH 53°25'30" EAST 69.42 FEET ALONG THE NORTHEASTERLY PROLONGATION OF THE SOUTHEASTERLY LINE OF SAID LAND; THENCE NORTH 36°19'50" WEST 47.29 FEET ALONG A LINE THAT IS PARALLEL WITH AND 5.00 FEET NORTHEASTERLY FROM THE NORTHEASTERLY FACE OF AN EXISTING BAM; THENCE NORTH 53°40'10" EAST 6.60 FEET TO A POINT WHICH IS 5.00 FEET SOUTHEASTERLY AND 1.00 FOOT NORTHEASTERLY FROM THE EASTERLY CORNER OF A 4' X 8' CONCRETE BASE OF A WATER WELL; THENCE NORTH 36°19'50" WEST, 18.00 FEET TO A POINT WHICH IS 5.00 FEET NORTHWESTERLY AND 1.00 FOOT NORTHWESTERLY FROM THE NORTHERLY CORNER OF THE CONCRETE BASE; THENCE SOUTH 53°40'10" WEST, 6.60 FEET TO A POINT THAT IS 5.00 FEET NORTHEASTERLY OF SAID BAM; THENCE NORTH 36°19'50" WEST, 108.71 FEET, PARALLEL WITH THE NORTHWESTERLY PROLONGATION OF THE NORTHEASTERLY FACE OF SAID BAM; THENCE SOUTH 47°43'44" WEST, 70.51 FEET TO THE MOST NORTHERLY COMER OF THE LAND DESCRIBED IN SAID DEED TO RALSTON ANDERSON AND MAXINE E. ANDERSON, THENCE SOUTH 36°34'30" EAST, 167.00 FEET ALONG THE NORTHEASTERLY LINE OF SAID LAND TO THE POINT OF BEGINNING.

EXCEPT THEREFROM ONE–HALF OF ALL MINERALS, OILS AND/OR ASPHALTUM OF EVERY KIND OR CHARACTER IN OR UNDER SAID PROPERTY, AND ONE–HALF OF EVERY MINERAL OR OIL RIGHT THEREIN, THEREUNTO AND THEREUNDER, AND THE RIGHTS AND EASEMENTS IN CONNECTION WITH SAID SUBSTANCES, AS RESERVED BY THE WHITING COMPANY IN THE DEED RECORDED IN BOOK 153 PAGE 320 OF OFFICIAL RECORDS.

ALSO EXCEPTING WATER AND WATER RIGHTS AS RESERVED BY THE WHITING COMPANY, IN DEED RECORDED IN BOOK 153 PAGE 320 OF OFFICIAL RECORDS.

NOTE: PARCELS A AND B ABOVE DESCRIBED ARE SHOWN AS PARCEL 1 ON THE LOT LINE ADJUSTMENT LL 82–30 RECORDED DECEMBER 22, 1982 AS INSTRUMENT NO. 82–449842, OFFICIAL RECORDS.

PARCEL C: (APPURTENANT EASEMENT PARCEL)

A NON–EXCLUSIVE EASEMENT FOR INGRESS AND EGRESS OVER THAT PORTION OF LOT F OF TRACT NO. 695, IN UNINCORPORATED TERRITORY OF THE COUNTY OF ORANGE, STATE OF CALIFORNIA, AS SHOWN ON A MAP RECORDED IN BOOK 25 PAGE 1 OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY INCLUDED WITHIN A STRIP OF LAND, 30.00 FEET IN WIDTH THE CENTERLINE OF SAID STRIP BEING DESCRIBED AS FOLLOWS:

BEGINNING AT THE MOST EASTERLY CORNER OF LOT 1 OF TRACT NO. 11397, AS SHOWN ON A MAP RECORDED IN BOOK 502 PAGES 44 THROUGH 47 INCLUSIVE OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, SAID COMER BEING ALSO THE NORTHWESTERLY LINE OF CANADA ROAD AS SHOWN ON SAID TRACT NO. 11397; THENCE NORTH 39°25'28" EAST 42.00 FEET ALONG SAID NORTHWESTERLY LINE TO THE TRUE POINT OF BEGINNING; THENCE NORTH 50°34'32" WEST 15.81 FEET TO THE BEGINNING OF A TANGENT CURVE CONCAVE SOUTHWESTERLY, HAVING A RADIUS OF 100.00 FEET; THENCE NORTHWESTERLY 73.23 FEEL ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 41°57'24"; THENCE SOUTH 87°28'04" WEST 96.78 FEET TO THE BEGINNING OF A TANGENT CURVE CONCAVE NORTHEASTERLY, HAVING A RADIUS OF 68.00 FEET; THENCE NORTHWESTERLY

LEGAL DESCRIPTION (CONTINUED)

49.52 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 41°43'42" TO THE BEGINNING OF A REVERSE CURVE, CONCAVE SOUTHWESTERLY, HAVING A RECORD OF 68.00 FEET; THENCE NORTHWESTERLY 49.52 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 41°43'42" TO A LINE PARALLEL WITH AND NORTHERLY 15.00 FEET FROM THAT CERTAIN COURSE SHOWN AS "NORTH 87°28'04" EAST 172.53 FEET" FOR A PORTION OF THE NORTHERLY LINE OF SAID LOT 1; THENCE SOUTH 87°28'04" WEST 172.53 FEET ALONG SAID PARALLEL LINE TO THE BEGINNING OF A TANGENT CURVE CONCAVE SOUTHEASTERLY, HAVING A RADIUS OF 68.00 FEET; THENCE SOUTHWESTERLY 41.99 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 35°22'46" TO THE BEGINNING OF A REVERSE CURVE, CONCAVE NORTHERLY, HAVING A RADIUS OF 68.00 FEET; THENCE WESTERLY 99.49 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 8349'42" TO A LINE PARALLEL WITH AND NORTHEASTERLY 45.00 FEET FROM THAT CERTAIN COURSE SHOWN AS "NORTH 44°05'00" WEST 142.84 FEET FOR A PORTION OF THE NORTHEASTERLY LINE OF SAID LOT 1; THENCE NORTH 44°05'00" WEST 101.68 FEET ALONG SAID LAST MENTIONED PARALLEL LINE TO A LINE PARALLEL WITH AND SOUTHEASTERLY 15.00 FEET FROM THE SOUTHEASTERLY LINE OF THE LAND DESCRIBED IN THE DEED TO DENVER A. NUTTER AND SADIE M. NUTTER RECORDED IN BOOK 247 PAGE 460 OF OFFICIAL RECORDS IN THE OFFICE OF THE COUNTY RECORDER; THENCE NORTH 53°25'30" EAST 257 98 FEET ALONG SAID LAST ABOVE MENTIONED PARALLEL LINE.

PARCEL D: (APPURTENANT EASEMENT PARCEL)

A NON–EXCLUSIVE EASEMENT FOR UTILITY PURPOSES AND INCIDENTAL PURPOSES THERETO OVER THAT PORTION OF LOT F OF TRACT NO. 695, IN THE UNINCORPORATED TERRITORY OF THE COUNTY OF ORANGE, STATE OF CALIFORNIA, AS SHOWN ON THE TERRITORY OF THE COUNTY OF ORANGE, STATE OF CALIFORNIA, AS SHOWN ON A MAP RECORDED IN BOOK 25 PAGE 1 OF MISCELLANEOUS MAPS IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY INCLUDED WITHIN A STRIP OF LAND, 30.00 FEET IN WIDTH, THE CENTERLINE OF SAID STRIP BEING DESCRIBED AS FOLLOWS:

COMMENCING AT THE SOUTHEASTERLY TERMINUS OF THAT CERTAIN COURSE SHOWN AS "NORTH 44°05*00" WEST 142.84 FEET" FOR A PORTION OF THE NORTHEASTERLY LINE OF LOT 1 OF TRACT NO. 11397, AS SHOWN ON A MAP RECORDED IN BOOK 502 PAGES 44 THROUGH 47 INCLUSIVE OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER; THENCE NORTH 45°36'44" EAST 15.00 FEET ALONG THE NORTHWESTERLY LINE OF SAID LOT 1 TO THE TRUE POINT OF BEGINNING, SAID POINT BEING ON LINE PARALLEL WITH AND NORTHEASTERLY 15.00 FEET FROM SAID NORTHEASTERLY LINE; THENCE NORTH 44°05'00" WEST 201.81 FEET ALONG SAID PARALLEL LINE TO A LINE PARALLEL WITH AND SOUTHEASTERLY 15.00 FEET FROM THE SOUTHEASTERLY LINE OF THE LAND DESCRIBED IN THE DEED TO DENVER A. NUTTER AND SADIE M. NUTTER RECORDED IN BOOK 2474 PAGE 460 OF OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER; THENCE NORTH 53°25'30" EAST 288.24 FEET ALONG SAID LAST MENTIONED PARALLEL LINE.

THE SIDELINES OF SAID STRIP TO BE PROLONGED OR SHORTENED TO TERMINATE SOUTHEASTERLY IN SAID NORTHWESTERLY LINE.

PARCEL 3:

PARCEL A: (FEE PARCEL)

THAT PORTION OF LOT F OF TRACT NO. 695, IN THE CITY OF LAKE FOREST, COUNTY OF ORANGE, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 25, PAGE 1 OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID ORANGE COUNTY, CALIFORNIA.

BEGINNING AT A POINT 615.77 FEET NORTH 23°03'40" WEST AND 275.00 FEET NORTH 53°25'30" EAST FROM THE MOST WESTERLY CORNER OF LOT G OF SAID TRACT NO. 695; THENCE NORTH 53°25'30" EAST 132.00 FEET; THENCE NORTH 33°34'30" WEST 90.00 FEET; THENCE SOUTH 53°25'30" WEST 132.00 FEET; THENCE SOUTH 33°34'30" EAST 90.00 FEET TO THE POINT OF BEGINNING.

EXCEPT ONE–HALF OF ALL MINERALS, OIL, AND/OR ASPHALTUM OF EVERY KIND OR CHARACTER IN OR UNDER SAID PROPERTY, AND ONE–HALF OF EVERY MINERAL OR OIL RIGHT THEREIN, THEREUNTO AND THEREUNDER, AS RESERVED BY THE WHITING COMPANY IN DEED RECORDED APRIL 30, 1928 IN BOOK 153, PAGE 320 OF OFFICIAL RECORDS.

PARCEL B: (APPURTENANT EASEMENT PARCEL)

A NON–EXCLUSIVE EASEMENT TO BE USED IN COMMON WITH OTHERS FOR INGRESS AND EGRESS, OVER THAT PORTION OF SAID LAND, INCLUDED WITHIN A STRIP OF LAND 30.00 FEET IN WIDTH, THE SOUTHWESTERLY AND NORTHWESTERLY LINES OF WHICH ARE DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT IN THE CENTERLINE OF CANADA ROAD, AS CONVEYED TO THE COUNTY OF ORANGE BY DEED RECORDED SEPTEMBER 26, 1938 IN BOOK 960, PAGES 514 OF OFFICIAL RECORDS OF ORANGE COUNTY, CALIFORNIA, SAID POINT BEING LOCATED 190.03 FEET NORTH 45°34'45" EAST AND 66.42 FEET SOUTH 44°05' EAST FROM THE MOST WESTERLY CORNER OF LOT G, TRACT NO. 695, AS PER MAP RECORDED IN BOOK 25, PAGE 1 OF MISCELLANEOUS MAPS, RECORDS OF ORANGE COUNTY, CALIFORNIA, RUNNING FROM SAID POINT OF BEGINNING NORTH 44°05' WEST 644.00 FEET; THENCE 53°25'30" EAST 438.00 FEET, AS SHOWN BY DEED RECORDED APRIL 25, 1961 IN BOOK 5700, PAGE 204 OF OFFICIAL RECORDS.

PARCEL C: (FEE PARCEL)

THE PARCEL OF LAND IN THE COUNTY OF ORANGE, STATE OF CALIFORNIA, DESCRIBED IN DEED RECORDED MARCH 24, 1953 IN BOOK 2474, PAGE 460 OF OFFICIAL RECORDS OF SAID COUNTY, TOGETHER WITH THAT PORTION OF LOT "F", TRACT NO. 695, AS SHOWN ON MAP RECORDED IN BOOK 25, PAGE 1 OF MISCELLANEOUS MAPS, RECORDS OF SAID COUNTY (MORE PARTICULARLY SHOWN AS "REMAINDER PARCEL" ON MAP OF SAID TRACT NO. 11397 RECORDED IN BOOK 502, PAGES 44 THROUGH 47 INCLUSIVE OF MISCELLANEOUS MAPS), DESCRIBED AS FOLLOWS:

BEGINNING AT THE WESTERLY CORNER OF SAID LAND DESCRIBED IN SAID DEED RECORDED MARCH 24, 1953 IN BOOK 2474, PAGE 460 OF OFFICIAL RECORDS; THENCE NORTH 33°34'30" WEST ALONG THE NORTHWESTERLY PROLONGATION OF THE SOUTHWESTERLY LINE OF SAID LAND 50.00 FEET; THENCE NORTH 74°31'39" EAST 138.68 FEET TO THE NORTHERLY CORNER OF SAID LAND; THENCE SOUTH 53°25'30" WEST ALONG THE NORTHWESTERLY LINE OF SAID LAND 132.00 FEET TO THE POINT OF BEGINNING OF THIS DESCRIPTION.

TITLE REPORT INFORMATION

ITEM NUMBERS AND LEGAL DESCRIPTION SHOWN HEREON CORRESPOND TO FIDELITY NATIONAL TITLE INSURANCE COMPANY PRELIMINARY TITLE REPORT NO. 989–30062340–A–BAM, DATED APRIL 19, 2021; AMENDED APRIL 27, 2021, AMENDMENT NO. A

NO RESPONSIBILITY FOR COMPLETENESS, ACCURACY OR CONTENT OF SAID REPORT IS ASSUMED BY THIS MAP.

ITEM NUMBERS INDICATED WITH A HEXAGON (⬡) REFLECT ITEMS WHICH ARE PLOTTED HEREON:

A TAXES.

B THE HEREIN DESCRIBED PROPERTY LIES WITHIN THE BOUNDARIES OF A MELLO–ROOS COMMUNITY FACILITIES DISTRICT (CFD).

C THE LIEN OF SUPPLEMENTAL OR ESCAPED ASSESSMENTS OF PROPERTY TAXES, IF ANY.

1 WATER RIGHTS, CLAIMS OR TITLE TO WATER, WHETHER OR NOT DISCLOSED BY THE PUBLIC RECORDS.

2 AN EASEMENT FOR ROAD, INGRESS AND EGRESS PURPOSES AS RESERVED IN THE GRANT DEED RECORDED APRIL 30, 1928, IN BOOK 153 PAGE 320, OFFICIAL RECORDS (EASEMENT NOT LOCATABLE FROM RECORD).

⟨3⟩ AN EASEMENT FOR PUBLIC UTILITY PURPOSES IN FAVOR OF SOUTHERN CALIFORNIA EDISON COMPANY RECORDED FEBRUARY 19, 1958, IN BOOK 4201 PAGE 456, OFFICIAL RECORDS.

4 AN EASEMENT FOR PUMPING STATION AND DISTRIBUTION SYSTEM PURPOSES IN FAVOR OF LOS ALISOS WATER DISTRICT RECORDED NOVEMBER 5, 1963, IN BOOK 6792, PAGE 419, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

5 EXCEPTIONS AND RESERVATIONS IN THE GRANT OF EASEMENT RECORDED NOVEMBER 5, 1963, IN BOOK 6792, PAGE 419, OFFICIAL RECORDS.

⟨6⟩ AN EASEMENT FOR PUBLIC UTILITY PURPOSES IN FAVOR OF SOUTHERN CALIFORNIA EDISON COMPANY RECORDED MAY 20, 1982, AS INSTRUMENT NO. 82–174560, OFFICIAL RECORDS, AND RE–RECORDED MAY 20, 1981, AS INSTRUMENT NO. 82–423781, OFFICIAL RECORDS.

7 AN EASEMENT FOR WATER AND SEWAGE PURPOSES IN FAVOR OF LOS ALISOS WATER DISTRICT RECORDED JUNE 24, 1982, AS INSTRUMENT NO. 82–217506, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

8 AN EASEMENT FOR WATER AND SEWAGE PURPOSES IN FAVOR OF LOS ALISOS WATER DISTRICT RECORDED JULY 7, 1982, AS INSTRUMENT NO. 82–234280, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

9 AN EASEMENT FOR INGRESS AND EGRESS AND UTILITY PURPOSES IN FAVOR OF GEORGE SALATA AND LINDA LEE SALATA RECORDED AUGUST 9, 1982, AS INSTRUMENT NO. 82–275009, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

⟨10⟩ AN EASEMENT FOR INGRESS AND EGRESS AND UTILITY PURPOSES IN FAVOR OF MICHAEL E. BROOKS AND DONNA V. BROOKS RECORDED SEPTEMBER 13, 1982, AS INSTRUMENT NO. 82–320345, OFFICIAL RECORDS.

⟨11⟩ AN EASEMENT FOR PUBLIC UTILITY PURPOSES IN FAVOR OF THE PACIFIC TELEPHONE AND TELEGRAPH COMPANY RECORDED OCTOBER 7, 1982, AS INSTRUMENT NO. 82–352902, OFFICIAL RECORDS.

12 AN EASEMENT FOR INGRESS AND EGRESS AND UTILITY PURPOSES IN FAVOR OF JAMES E. JOHNSON RECORDED NOVEMBER 24, 1982, AS INSTRUMENT NO. 82–414655, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

13 AN EASEMENT FOR INGRESS AND EGRESS AND UTILITY PURPOSES IN FAVOR OF DONALD G. HESS AND JANICE C. HESS RECORDED MARCH 9, 1983, AS INSTRUMENT NO. 83–102136, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

⟨14⟩ AN EASEMENT FOR SEWER PURPOSES IN FAVOR OF LOS ALISOS WATER DISTRICT RECORDED JUNE 25, 1987, AS INSTRUMENT NO. 87–36172, OFFICIAL RECORDS.

⟨15⟩ AN EASEMENT FOR STORM DRAIN PURPOSES DEDICATED TO THE COUNTY OF ORANGE ON PARCEL MAP NO. 86–133, P.M.B. 225/7–13.

⟨16⟩ AN EASEMENT FOR RECREATION RIDING AND HIKING TRAIL PURPOSES DEDICATED TO AND NOT ACCEPTED BY THE COUNTY OF ORANGE ON PARCEL MAP NO. 86–133, P.M.B. 225/7–13.

⟨17⟩ AN EASEMENT FOR STORM DRAIN PURPOSES DEDICATED TO THE COUNTY OF ORANGE ON PARCEL MAP NO. 86–133, P.M.B. 225/7–13.

18 AN EASEMENT FOR AVIGATION PURPOSES DEDICATED TO THE COUNTY OF ORANGE ON PARCEL MAP NO. 86–133, P.M.B. 225/7–13 (EASEMENT IS BLANKET IN NATURE).

⟨19⟩ AN EASEMENT FOR FLOOD PLAIN PURPOSES DEDICATED TO THE ORANGE COUNTY FLOOD CONTROL DISTRICT ON PARCEL MAP NO. 86–133, P.M.B. 225/7–13.

20 MATTERS CONTAINED IN THE DOCUMENT ENTITLED "AGREEMENT FOR DRAINAGE ENCUMBRANCE" RECORDED MARCH 31, 1988, AS INSTRUMENT NO. 88–149591, OFFICIAL RECORDS (CONTAINS AN AGREEMENT TO ACCEPT SURFACE DRAINAGE).

21 COVENANTS, CONDITIONS, RESTRICTIONS AND EASEMENTS PER DOCUMENT RECORDED JANUARY 19, 1989, AS INSTRUMENT NO. 89–033395, OFFICIAL RECORDS AND MODIFIED BY DOCUMENT RECORDED JANUARY 19, 1989, AS INSTRUMENT NO. 89–033395, OFFICIAL RECORDS (DOCUMENT CONTAINS EASEMENTS FOR INGRESS, EGRESS, CONSTRUCTION AND MAINTENANCE PURPOSES, EASEMENTS ARE BLANKET IN NATURE).

22 AN EASEMENT FOR INGRESS, EGRESS, CONSTRUCTION AND MAINTENANCE PURPOSES IN FAVOR OF DIMENSION BUSINESS PARK ASSOCIATION, RECORDED JULY 19, 1994, AS INSTRUMENT NO. 94–0448986, OFFICIAL RECORDS (EASEMENTS ARE BLANKET IN NATURE).

TITLE REPORT INFORMATION (CONTINUED)

23 STANDARD TITLE COMPANY NOTE.

⟨24⟩ ITEM IS IDENTICAL TO ITEM NO. 2 ABOVE.

25 STANDARD TITLE COMPANY NOTE.

26 THE RIGHT TO BORE AND SINK WELLS ON THIS, AND OTHER LAND, AND EASEMENTS FOR PIPE LINES, CONDUITS, DITCHES AND OTHER INCIDENTAL PURPOSES, TOGETHER WITH THE RIGHT TO BORE AND SINK WELLS IN CONNECTION WITH SAID WELLS, AS RESERVED.

27 A RIGHT OF WAY TO A WELL AND PUMPING PLANT RESERVED IN GRANT DEED RECORDED JULY 25, 1934, IN BOOK 690, PAGE 313, OFFICIAL RECORDS (RIGHT OF WAY NOT LOCATABLE FROM RECORD).

28 EASEMENTS AND RIGHTS OF WAY FOR ROAD AND PUBLIC UTILITIES, AND APPURTENANCES THERETO, AS RESERVED AND CONVEYED BY VARIOUS DEEDS OF RECORD.

⟨29⟩ ITEM IS IDENTICAL TO ITEM NO. 6 ABOVE.

30 ITEM IS IDENTICAL TO ITEM NO. 7 ABOVE.

31 ITEM IS IDENTICAL TO ITEM NO. 8 ABOVE.

32 ITEM IS IDENTICAL TO ITEM NO. 9 ABOVE.

33 ITEM IS IDENTICAL TO ITEM NO. 9 ABOVE.

⟨34⟩ ITEM IS IDENTICAL TO ITEM NO. 11 ABOVE.

35 ITEM IS IDENTICAL TO ITEM NO. 12 ABOVE.

⟨36⟩ ITEM IS IDENTICAL TO ITEM NO. 10 ABOVE.

37 AN EASEMENT FOR DRAINAGE AND RIDING AND HIKING TRAIL PURPOSES RESERVED IN THE GRANT DEED RECORDED MARCH 9, 1983, AS INSTRUMENT NO. 83–102135, OFFICIAL RECORDS (DRAINAGE EASEMENT IS NOT LOCATABLE FROM RECORD; RIDING AND HIKING TRAIL EASEMENT IS BLANKET IN NATURE).

38 STANDARD TITLE COMPANY NOTE.

39 ITEM IS IDENTICAL TO ITEM NO. 13 ABOVE.

40 DISCREPANCIES, CONFLICTS IN BOUNDARY LINES, SHORTAGE IN AREA, ENCROACHMENTS, OR ANY OTHER MATTERS SHOWN ON RECORD OF SURVEY 86–1057, R.S.B. 113/48–49.

41 STANDARD TITLE COMPANY NOTE.

42 ITEM IS IDENTICAL TO ITEM NO. 2 ABOVE.

43 ITEM IS IDENTICAL TO ITEM NO. 2 ABOVE.

44 ITEM IS IDENTICAL TO ITEM NO. 2 ABOVE.

45 THE AFFECT OF A WAIVER.

46 ITEM IS IDENTICAL TO ITEM NO. 27 ABOVE.

47 A RIGHT OF WAY TO A WELL AND PUMPING PLANT RESERVED IN GRANT DEED RECORDED JANUARY 4, 1951, IN BOOK 2124, PAGE 240, OFFICIAL RECORDS (RIGHT OF WAY NOT LOCATABLE FROM RECORD).

48 AN EASEMENT FOR PUBLIC UTILITY PURPOSES IN FAVOR OF SOUTHERN CALIFORNIA EDISON COMPANY RECORDED SEPTEMBER 26, 1951, IN BOOK 2234 PAGE 520, OFFICIAL RECORDS (EASEMENT IS NOT LOCATABLE FROM RECORD).

49 ITEM IS IDENTICAL TO ITEM NO. 40 ABOVE.

50 A DEED OF TRUST.

51 ANY EASEMENTS NOT DISCLOSED BY THE PUBLIC RECORDS AS TO MATTERS AFFECTING TITLE TO REAL PROPERTY, WHETHER OR NOT SAID EASEMENTS ARE VISIBLE AND APPARENT.

52 MATTERS WHICH MAY BE DISCLOSED BY AN INSPECTION AND/OR BY A CORRECT ALTA/NSPS LAND TITLE SURVEY OF SAID LAND, AND/OR BY INQUIRY OF THE PARTIES IN POSSESSION THEREOF.

53 ANY RIGHTS OF THE PARTIES IN POSSESSION OF A PORTION OF, OR ALL OF, SAID LAND, WHICH RIGHTS ARE NOT DISCLOSED BY THE PUBLIC RECORDS.

54 AN EASEMENT FOR SCENIC PRESERVATION AND OPEN SPACE DEDICATED TO THE COUNTY OF ORANGE ON PARCEL MAP NO. 86–133, P.M.B. 225/7–13 (EASEMENT IS BLANKET IN NATURE OVER PARCEL 1 OF THE LEGAL DESCRIPTION).

AN EASEMENT FOR FLOOD PLAIN PURPOSES DEDICATED TO THE ORANGE COUNTY FLOOD CONTROL DISTRICT ON PARCEL MAP NO. 86–133, P.M.B. 225/7–13 (SHOWN HEREON AS ITEM NO. 19).

NOTES

1. BASIS OF BEARINGS: BEARINGS SHOWN HEREON ARE BASED ON THE CENTERLINE OF LINEAR LANE BEING NORTH 22°19'33" EAST ON PARCEL MAP NO. 86–133, P.M.B. 225/7–13.
2. ASSESSOR'S PARCEL NO. = 610–301–07, 610–301–20, & 610–301–21 (ASSESSOR'S PARCEL NUMBERS SHOWN HEREON ARE PER THE CURRENT TAX ASSESSOR'S ROLLS AS PROVIDED BY FIDELITY NATIONAL TITLE INSURANCE COMPANY.
3. AERIAL PHOTOGRAPHY WAS COMPILED BY ROBERT J. LUNG & ASSOCIATES, DATED FEBRUARY 8, 2019, AND COMPLIES WITH NATIONAL MAPPING ACCURACY STANDARDS.
4. PARCEL B OF PARCEL 3 OF THE LEGAL DESCRIPTION IS AN APPURTENANT EASEMENT THAT, AS DESCRIBED, RUNS THROUGH AN EXISTING CONDOMINIUM COMPLEX.
5. BOUNDARY INFORMATION SHOWN HEREON WAS COMPILED FROM RECORD DATA AND DOES NOT REPRESENT A FIELD SURVEY.

DIG ALERT — DIAL TOLL FREE 1-800-2□□-2600 — AT LEAST TWO DAYS BEFORE YOU DIG — UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

CLIENT

Great Scott Tree Care

20865 Canada Road Lake Forest

PR□□ECT NAME

PR□□ECT N□MBER

R308444.01

B□ILDER

DESIGN C□NS□LTANT

HUITT-ZOLLARS
Huitt-Zollars, Inc. Irvine
2603 Main Street, Suite 400
Irvine, California 92614
Phone (949) 988-5815 Fax (949) 988-5820

REGISTRATI□N STAMP

PROFESSIONAL LAND SURVEYOR — RUSSELL H. HANSON — NO. 8873 — STATE OF CALIFORNIA

AGENCY APPR□□AL

DIVISION OF THE STATE ARCHITECT
APPL #
FILE #
AC ____ FLS ____
SSS ____ DATE ____
IDENTIFICATION STAMP

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DESIGNER PR□□. N□. R308444.01
DRAWN BY:
CHEC□ED BY:
SCALE:

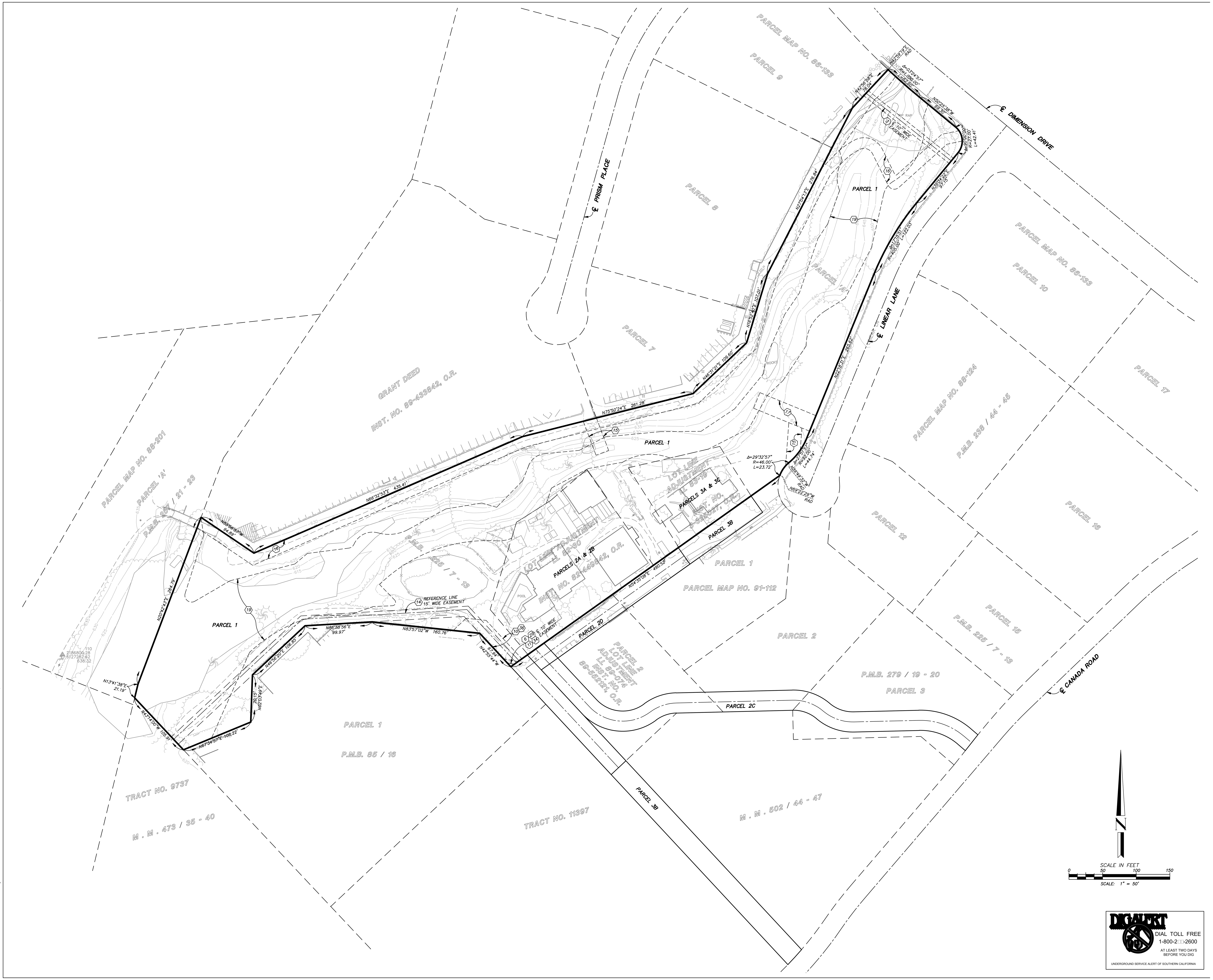
□EY PLAN

SHEET TITLE

ENCUMBRANCE MAP GREAT SCOTT PROPERTY

SHEET N□MBER

C2.0



CLIENT

Great Scott Tree Care

20865 Canada Road Lake Forest

PROJECT NAME

PROJECT NUMBER

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BUILDER

DESIGN CONSULTANT

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FILE #
AC ____ FLS ____
SSS ____ DATE ____
IDENTIFICATION STAMP

ISSUE

MARK	DATE	DESCRIPTION

DESIGNER PROJ. NO. R308444.01
DRAWN BY:
CHECKED BY:
SCALE:

KEY PLAN

SHEET TITLE

ENCUMBRANCE MAP
GREAT SCOTT
PROPERTY

SHEET NUMBER

C2.1

03/31/21

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4/28/21 DMACKEY

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Orange County and Part of Riverside County, California

December 6, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:2,460 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator   Corner coordinates: WGS84   Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 13, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 3, 2015—Jan 17, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
142	Cieneba sandy loam, 30 to 75 percent slopes, eroded	0.3	3.9%
176	Myford sandy loam, 15 to 30 percent slopes	0.1	1.1%
191	Riverwash	4.6	57.3%
207	Sorrento loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	3.0	37.7%
Totals for Area of Interest		**8.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Orange County and Part of Riverside County, California

142—Cieneba sandy loam, 30 to 75 percent slopes, eroded

Map Unit Setting

National map unit symbol: hcml
Elevation: 500 to 4,000 feet
Mean annual precipitation: 12 to 35 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 200 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Cieneba and similar soils: 65 percent
Minor components: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cieneba

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave, convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite

Typical profile

H1 - 0 to 7 inches: sandy loam
H2 - 7 to 59 inches: weathered bedrock

Properties and qualities

Slope: 30 to 75 percent
Depth to restrictive feature: 4 to 20 inches to paralithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: SHALLOW LOAMY (1975) (R019XD060CA)
Hydric soil rating: No

Minor Components

Cieneba, uneroded

Percent of map unit: 10 percent
Hydric soil rating: No

Vista, sandy loam
Percent of map unit: 5 percent
Hydric soil rating: No

San andreas, sandy loam
Percent of map unit: 5 percent
Hydric soil rating: No

Soper, cobbly loam
Percent of map unit: 5 percent
Hydric soil rating: No

Calleguas, clay loam
Percent of map unit: 5 percent
Hydric soil rating: No

Tollhouse
Percent of map unit: 2 percent
Hydric soil rating: No

Rock outcrop
Percent of map unit: 2 percent
Hydric soil rating: No

Blasingame, loam
Percent of map unit: 1 percent
Hydric soil rating: No

176—Myford sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hcnp
Elevation: 1,500 feet
Mean annual precipitation: 12 to 20 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 270 to 350 days
Farmland classification: Not prime farmland

Map Unit Composition

Myford and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Myford

Setting
Landform: Terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from mixed

Typical profile

H1 - 0 to 12 inches: sandy loam
H2 - 12 to 18 inches: sandy clay
H3 - 18 to 28 inches: sandy clay loam
H4 - 28 to 71 inches: sandy clay loam
H5 - 71 to 79 inches: sandy loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: About 12 inches to abrupt textural change
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: CLAYPAN (1975) (R019XD061CA)
Hydric soil rating: No

Minor Components

Myford, sandy loam, eroded

Percent of map unit: 5 percent
Hydric soil rating: No

Myford, less sloping or steeper

Percent of map unit: 5 percent
Hydric soil rating: No

Cieneba, sandy loam

Percent of map unit: 3 percent
Hydric soil rating: No

Yorba, gravelly sandy loam

Percent of map unit: 2 percent
Hydric soil rating: No

191—Riverwash

Map Unit Composition

Riverwash: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverwash

Setting

Landform: Fans
Parent material: Sandy and gravelly alluvium

Typical profile

C1 - 0 to 6 inches: gravelly sand
C2 - 6 to 60 inches: stratified gravelly coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Frequent
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydric soil rating: Yes

207—Sorrento loam, 2 to 9 percent slopes, warm MAAT, MLRA 19

Map Unit Setting

National map unit symbol: 2tz0c
Elevation: 0 to 1,340 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 62 to 66 degrees F
Frost-free period: 320 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sorrento and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sorrento

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

A - 0 to 12 inches: loam
AB - 12 to 37 inches: silty clay loam
Bk - 37 to 62 inches: silty clay loam

2C - 62 to 72 inches: sandy loam

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: LOAMY (1975) (R019XD029CA)
Hydric soil rating: No

Minor Components

Mocho

Percent of map unit: 7 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Botella

Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: LOAMY (1975) (R019XD029CA)
Hydric soil rating: No

Pico

Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Garretson

Percent of map unit: 2 percent
Landform: Alluvial fans

Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Anacapa

Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

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Map of Statutory Natural Hazards
For ORANGE County

Property Address: VACANT AND 20865 CANADA RD
LAKE FOREST, ORANGE COUNTY, CA 92630
("Property")

APN: See Addendum
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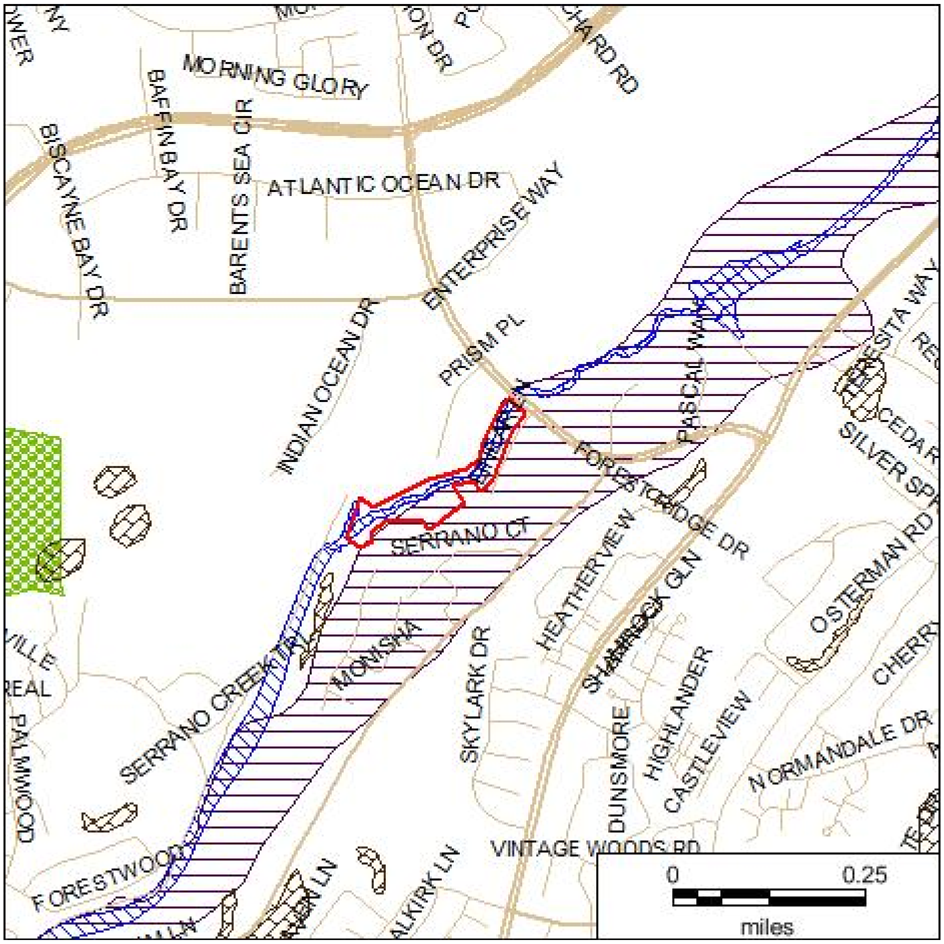

Subject Property

- Special Flood Hazard Area
- Area of Potential Flooding, Dam Failure
- Very High Fire Hazard Severity Zone
- Wildland Area, Substantial Forest Fire Risk
- Earthquake Fault Zone
- Seismic Hazard Zone, Landslide
- Seismic Hazard Zone, Liquefaction

This map is provided for convenience only to show the approximate location of the Property and is not based on a field survey.

This COMMERCIAL PROPERTY DISCLOSURE REPORT contains

THIS REPORT PROVIDES THE STATUTORY DISCLOSURES MANDATED BY CALIFORNIA LAWS SPECIFIED HEREIN AND DELIVERY OF THIS REPORT AND THE EXECUTED STATUTORY FORM IS SUFFICIENT TO MEET THE SAFE HARBOR FOR THE SELLER AND SELLER'S AGENT. THIS REPORT ALSO CONTAINS OTHER IMPORTANT DISCLOSURES AND INFORMATION. SELLER AND SELLER'S AGENT MAY HAVE ADDITIONAL RESPONSIBLITIES FOR CERTAIN DISCLOSURES WITHIN THEIR ACTUAL KNOWLEDGE.

The Natural Hazard Disclosure Report
For ORANGE County

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ADDENDUM FOR ASSESSOR PARCEL NUMBERS

This Addendum pertains solely to Report No. 2419042 dated Friday, January 25, 2019("Report Date") for disclosure information with respect to the Property, situated in the County of ORANGE, State of California, as collectively constituted by only those 2 assessor parcel numbers ("APN") and geographic boundaries thereof listed below as provided to the Company on said Report Date:

610-301-20 610-301-07

Responses contained in this Report pertain only to Property as identified above and to no others pursuant to a Transaction. This Report should not to be used for, and liability shall not be applicable to, any transaction involving any fewer or any other parcels than those identified above. For liability purposes a Report should be ordered for an individual parcel should it be sold separately from other parcels in a separate transaction.

This Addendum is attached hereto and made a part of Report No. 2419042 as of this reference and is subject to the Terms and Conditions contained herein.

The Natural Hazard Disclosure Report For ORANGE County

Property Address: VACANT AND 20865 CANADA RD
LAKE FOREST, ORANGE COUNTY, CA 92630
("Property")

APN: See Addendum
Report Date: 01/25/2019
Report Number: 2419042

Natural Hazard Disclosure ("NHD") Statement and Acknowledgment of Receipt

The transferor and his or her agent(s) or a third-party consultant disclose the following information with the knowledge that even though this is not a warranty, prospective transferees may rely on this information in deciding whether and on what terms to purchase the Property. Transferor hereby authorizes any agent(s) representing any principal(s) in this action to provide a copy of this statement to any person or entity in connection with any actual or anticipated sale of the Property.

The following are representations made by the transferor and his or her agent(s) or a third-party consultant based on their knowledge and maps drawn by the State. This information is a disclosure and is not intended to be part of any contract between the transferee and the transferor. THIS REAL PROPERTY LIES WITHIN THE FOLLOWING HAZARDOUS AREA(S):

A SPECIAL FLOOD HAZARD AREA (Any type Zone "A" or "V") designated by the Federal Emergency Management Agency

Yes **X** No___ Do not know and information not available from local jurisdiction ___

AN AREA OF POTENTIAL FLOODING shown on a dam failure inundation map pursuant to Section 8589.5 of the Government Code.

Yes___ No **X** Do not know and information not available from local jurisdiction___

A VERY HIGH FIRE HAZARD SEVERITY ZONE pursuant to Section 51178 or 51179 of the Government Code. The owner of this Property is subject to the maintenance requirements of Section 51182 of the Government Code.

Yes___ No **X**

A WILDLAND AREA THAT MAY CONTAIN SUBSTANTIAL FOREST FIRE RISK AND HAZARDS pursuant to Section 4125 of the Public Resources Code. The owner of this Property is subject to the maintenance requirements of Section 4291 of the Public Resources Code. Additionally, it is not the state's responsibility to provide fire protection services to any building or structure located within the wildlands unless the Department of Forestry and Fire Protection has entered into a cooperative agreement with a local agency for those purposes pursuant to Section 4142 of the Public Resources Code.

Yes___ No **X**

AN EARTHQUAKE FAULT ZONE pursuant to Section 2622 of the Public Resources Code.

Yes___ No **X**

A SEISMIC HAZARD ZONE pursuant to Section 2696 of the Public Resources Code.

Yes (Landslide Zone)___ Yes (Liquefaction Zone) **X**

No___ Map not yet released by state___

THESE HAZARDS MAY LIMIT YOUR ABILITY TO DEVELOP THE REAL PROPERTY, TO OBTAIN INSURANCE, OR TO RECEIVE ASSISTANCE AFTER A DISASTER. THE MAPS ON WHICH THESE DISCLOSURES ARE BASED ESTIMATE WHERE NATURAL HAZARDS EXIST. THEY ARE NOT DEFINITIVE INDICATORS OF WHETHER OR NOT A PROPERTY WILL BE AFFECTED BY A NATURAL DISASTER. TRANSFEREE(S) AND TRANSFEROR(S) MAY WISH TO OBTAIN PROFESSIONAL ADVICE REGARDING THOSE HAZARDS AND OTHER HAZARDS THAT MAY AFFECT THE PROPERTY.

Signature of Transferor(s)	Date	Signature of Transferor(s)	Date
Signature of Agent	Date	Signature of Agent	Date

☐ Transferor(s) and their agent(s) represent that the information herein is true and correct to the best of their knowledge as of the date signed by the transferor(s) and agent(s).

☒ Transferor(s) and their agent(s) acknowledge that they have exercised good faith in the selection of a third-party report provider as required in Civil Code Section 1103.7, and that the representations made in this Natural Hazard Disclosure Statement are based upon information provided by the independent third-party disclosure provider as a substituted disclosure pursuant to Civil Code Section 1103.4. Neither transferor(s) nor their agent(s) (1) has independently verified the information contained in this statement and Report or (2) is personally aware of any errors or inaccuracies in the information contained on the statement. This statement was prepared by the provider below:

Third-Party Disclosure Provider(s) FIRST AMERICAN PROFESSIONAL REAL ESTATE SERVICES, INC. OPERATING THROUGH ITS FANHD DIVISION.
Date 25 January 2019

Transferee represents that he or she has read and understands this document. Pursuant to Civil Code Section 1103.8, the representations in this Natural Hazard Disclosure Statement do not constitute all of the transferor's or agent's disclosure obligations in this transaction.

Signature of Transferee(s)	Date	Signature of Transferee(s)	Date

TRANSFEREE(S) REPRESENTS ABOVE HE/SHE HAS RECEIVED, READ AND UNDERSTANDS THE COMPLETE FANHD DISCLOSURE REPORT DELIVERED WITH THIS SUMMARY:

A. Commercial Natural Hazard Disclosure Report.
B. Additional Property-specific Statutory Disclosures: Former Military Ordnance Site, Airport Influence Area, Airport Noise, San Francisco Bay Conservation and Development District Jurisdiction (in S.F. Bay counties only).
C. Additional County and City Regulatory Determinations as applicable: Airports, Avalanche, Blow Sand, Coastal Zone, Dam/Levee Failure Inundation, Debris Flow, Erosion, Flood, Fault Zone, Fire, Groundwater, Landslide, Liquefaction, Methane Gas, Mines, Naturally Occurring Asbestos, Redevelopment Area, Right to Farm, Runoff Area, Seiche, Seismic Shaking, Seismic Ground Failure, Slope Stability, Soil Stability, Subsidence, TRPA, Tsunami.
D. General advisories: Methamphetamine Contamination, Mold, Radon, Endangered Species Act, Abandoned Mines, Oil & Gas Wells, Tsunami Maps (coastal only), Non-residential Building Energy Use.
E. Government Guides in Combined Booklet with Report. Refer to Booklet: Commercial Property Owner's Guide to Earthquake Safety. Government Guides are also available on the Company's "Electronic Bookshelf" at http://wwww.disclosures.com/.

Property Address: VACANT AND 20865 CANADA RD
LAKE FOREST, ORANGE COUNTY, CA 92630
("Property")

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PROPERTY DISCLOSURE SUMMARY - READ FULL REPORT

Statutory NHD Determinations	IN	NOT IN	Map N/A*	Property is:	NHD Report page:
Flood	X			IN a Special Flood Hazard Area. The Property is IN a FEMA-designated Flood Zone(s) AE, X.	7
Dam		X		NOT IN an area of potential dam inundation.	7
Very High Fire Hazard Severity		X		NOT IN a very high fire hazard severity zone.	8
Wildland Fire Area		X		Not in a wildland-state responsibility area.	8
Fault		X		NOT IN an earthquake fault zone designated pursuant to the Alquist-Priolo Act.	9
Landslide		X		NOT IN an area of earthquake-induced land sliding designated pursuant to the Seismic Hazard Mapping Act.	9
Liquefaction	X			IN an area of potential liquefaction designated pursuant to the Seismic Hazard Mapping Act.	9

County-level NHD Determinations	IN	NOT IN	Map N/A*	Property is:	NHD Report page:
Tsunami		X		NOT IN a mapped tsunami runup area	11
Ground Shaking	X			IN Seismic Shaking Zone B, a mapped relative seismic shaking zone with intermediate shaking potential.	11
Expansive Soils	X			IN a mapped area with low soil expansivity potential	12
Fault		X		NOT WITHIN one-eighth of one mile of a mapped fault trace	11
Liquefaction		X		NOT IN an area of high or moderate liquefaction potential	11
Landslide	X			IN an area of moderately low (Zone 2) or very low potential (Zone 1) for massive bedrock landslides under earthquake conditions.	11
Debris Flow		X		NOT IN a mapped source area of high propensity for either mud-debris flow or rock fall during periods of exceptionally high rainfall or during seismic shaking	11

City-level NHD Determinations	IN	NOT IN	Map N/A*	Property is:	NHD Report page:
Fire Hazard		X		NOT IN a mapped Fire Hazard Area.	13

Additional Statutory Disclosures	IN	NOT IN	Map N/A*	Property is:	NHD Report page:
Former Military Ordnance		X		NOT WITHIN one mile of a formerly used ordnance site.	14
Airport Influence Area		X		NOT IN an airport influence area.	15
Airport Noise Area for 65 Decibel		X		NOT IN a delineated 65 dB CNEL or greater aviation noise zone.	16

General Advisories	Description	NHD Report page:
Methamphetamine Contamination	Provides an advisory that a disclosure may be required pursuant to the "Methamphetamine Contaminated Property Cleanup Act of 2005".	17
Mold	Provides an advisory that all prospective purchasers of residential and commercial property should thoroughly inspect the subject property for mold and sources for additional information on the origins of and the damage caused by mold.	18
Radon	Provides an advisory on the risk associated with Radon gas concentrations.	19
Endangered Species	Provides an advisory on resources to educate the public on locales of endangered or threatened species.	19
Abandoned Mines	Provides an advisory on resources to educate the public on the hazards posed by, and some of the general locales of, abandoned mines.	20

The Natural Hazard Disclosure Report For ORANGE County

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General Advisories	Description	NHD Report page:
Oil and Gas Wells	Provides an advisory on the potential existence of oil and gas wells and sources for additional general and/or specific information.	20
Tsunami Map Advisory	Provides an advisory about maximum tsunami inundation maps issued for jurisdictional emergency planning.	21

Determined by First American Professional Real Estate Services, Inc.

For more detailed information as to the foregoing determinations, please read this entire Report.

Natural Hazard Disclosure Report

Part 1. State Defined Natural Hazard Zones

Statutory Natural Hazard Disclosures

Section 1103 of the California Civil Code mandates the disclosure of six (6) natural hazard zones if the Property is located within any such zone. Those six "statutory" hazard zones, disclosed on the **Natural Hazard Disclosure Statement** ("NHDS") on Page one of this Report, are explained below. Note that the NHDS does not provide for informing buyers if a property is only partially within any of the delineated zones or provide additional flood zone information which could be very important to the process. The following summary is intended to give buyers additional information they may need to help them in the decision-making process and to place the information in perspective.

SPECIAL FLOOD HAZARD AREA

DISCUSSION: Property in a Special Flood Hazard Area (any type of Zone "A" or "V" as designated by the Federal Emergency Management Agency ("FEMA") is subject to flooding in a "100-year rainstorm." Federally connected lenders require homeowners to maintain flood insurance for buildings in these zones. A 100-year flood occurs on average once every 100 years, but may not occur in 1,000 years or may occur in successive years. According to FEMA, a home located within a SFHA has a 26% chance of suffering flood damage during the term of a 30-year mortgage. Other types of flooding, such as dam failure, are not considered in developing these zones. Flood insurance for properties in Zones B, C, D, X, X500, and X500_Levee is available but is not required.

Zones A, AO, AE, AH, AR, A1-A30: Area of "100-year" flooding - a 1% or greater chance of annual flooding.
Zone A99: An “adequate progress” determination for flood control system construction projects that, once completed, may significantly limit the area of a community that will be included in the Special Flood Hazard Area (SFHA). Such projects reduce but do not eliminate, the risk of flooding to people and structures in “levee-impacted” areas, and allow mandatory flood insurance to be available at a lower cost.
Zones V, V1-V30: Area of "100-year" flooding in coastal (shore front) areas subject to wave action.
Zone B: Area of moderate flood risk. These are areas between the "100" and "500" year flood-risk levels.
Zones C, D: NOT IN an area of "100-year" flooding. Area of minimal (Zone C) or undetermined (Zone D) flood hazard.
Zones X: An area of minimal flood risk. These are areas outside the "500" year flood-risk level.
Zone X500: An area of moderate flood risk. These are areas between the "100" and "500" year flood-risk levels.
Zone X500_LEVEE: An area of moderate flood risk that is protected from "100-year flood" by levee and that is subject to revision to high risk (Zone A) if levee is decertified by FEMA.
Zone N: Area Not Included, no flood zone designation has been assigned or not participating in the National Flood Insurance Program.

Notice: The Company is not always able to determine if the Property is subject to a FEMA Letter of Map Revision ("LOMR") or other FEMA letters of map change. If Seller is aware that the Property is subject to a LOMR or other letters of map change, the Seller shall disclose the map change and attach a copy of the FEMA letter(s) to the Report. Contact FEMA at http://msc.fema.gov for additional information.

For more information about flood zones, visit:
http://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/defining_flood_risks.jsp

PUBLIC RECORD: Official Flood Insurance Rate Maps ("FIRM") compiled and issued by the Federal Emergency Management Agency ("FEMA") pursuant to 42 United States Code §4001, et seq.

AREA OF POTENTIAL FLOODING (DAM FAILURE)

DISCUSSION: Local governmental agencies, utilities, and owners of certain dams are required to prepare and submit inundation maps for review and approval by the California Office of Emergency Services ("OES"). A property within an Area of Potential Flooding Caused by Dam Failure is subject to potential flooding in the event of a sudden and total dam failure with a full reservoir. Such a failure could result in property damage and/or personal injury. However, dams rarely fail instantaneously and reservoirs are not always filled to capacity. Please note that not all dams (such as federally controlled dams) located within the state have been included within these dam inundation zones. Also these maps do not identify areas of potential flooding resulting from storms or other causes.

PUBLIC RECORD: Official dam inundation maps or digital data thereof made publicly available by the State of California Office of Emergency Services ("OES") pursuant to California Government Code §8589.5.

VERY HIGH FIRE HAZARD SEVERITY ZONE (VHFHSZ)

DISCUSSION: VHFHSZs can be defined by the California Department of Forestry and Fire Protection ("Calfire") as well as by local fire authorities within "Local Responsibility Areas" where fire suppression is the responsibility of a local fire department. Properties located within VHFHS Zones may have a higher risk for fire damage and, therefore, may be subject to (i) additional construction requirements such as a "Class A" roof for new construction or replacement of existing roofs; and (ii) additional maintenance responsibilities such as adequate vegetation clearance near the structure, spark screens on chimneys and stovepipes, leaf removal from roofs, and other basic fire-safety practices. Contact the local fire department for a complete list of requirements and exceptions.

PUBLIC RECORD: Maps issued by Calfire pursuant to California Government Code § 51178 recommending VHFHSZs to be adopted by the local jurisdiction within its Local Responsibility Area, or VHFHSZs adopted by the local jurisdiction within the statutory 120-day period defined in California Government Code § 51179.

WILDLAND FIRE AREA (STATE RESPONSIBILITY AREA)

DISCUSSION: The State Board of Forestry classifies all lands within the State of California based on various factors such as ground cover, beneficial use of water from watersheds, probable damage from erosion, and fire risks. Fire prevention and suppression in all areas which are not within a Wildland - State Responsibility Area ("WSRA") is primarily the responsibility of the local or federal agencies, as applicable.

For property located within a WSRA, please note that (1) there may be substantial forest fire risks and hazards; (2) except for property located within a county which has assumed responsibility for prevention and suppression of all fires, it is NOT the state's responsibility to provide fire protection services to any building or structure located within a WSRA unless the Department has entered into a cooperative agreement with a local agency; and (3) the property owner may be is subject to (i) additional construction requirements such as a "Class A" roof for new construction or replacement of existing roofs; and (ii) additional maintenance responsibilities such as adequate vegetation clearance near the structure, spark screens on chimneys and stovepipes, leaf removal from roofs, and other basic fire-safety practices.

The existence of local agreements for fire service is not available in the Public Record and, therefore, is not included in this disclosure. For very isolated properties with no local fire services or only seasonal fire services there may be significant fire risk. If the Property is located within a WSRA, please contact the local fire department for more detailed information.

PUBLIC RECORD: Official maps issued by the California Department of Forestry and Fire Protection ("Calfire") pursuant to California Public Resources Code § 4125.

SRA Fire Prevention Benefit Fee Advisory

In 2011, the California Legislature and Governor enacted a "Fire Prevention Fee" on habitable structures in the State's wildland fire responsibility area. The yearly fee, levied on property owners, paid for various activities to prevent and suppress wildfires in the SRA, and was most recently at the rate of $152.33 per habitable structure on the property.

Effective July 1, 2017, as authorized by Assembly Bill 398 and signed by the Governor, that fire prevention fee is suspended until 2031.

For more information, please refer to "Part 6. State Responsibility Area Fire Prevention Fee" in the FANHD Property Tax Report.

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EARTHQUAKE FAULT ZONE

DISCUSSION: Earthquake Fault Zones are delineated and adopted by California as part of the Alquist-Priolo Earthquake Fault Zone Act of 1972. Property in an Earthquake Fault Zone ("EF Zone") does not necessarily have a fault trace existing on the site. EF Zones are areas or bands delineated on both sides of known active earthquake faults. EF Zones vary in width but average one-quarter (1/4) mile in width with the "typical" zone boundaries set back approximately 660 feet on either side of the fault trace. The potential for "fault rupture" damage (ground cracking along the fault trace) is relatively high only if a structure is located directly on a fault trace. If a structure is not on a fault trace, shaking will be the primary effect of an earthquake. During a major earthquake, shaking will be strong in the vicinity of the fault and may be strong at some distance from the fault depending on soil and bedrock conditions. It is generally accepted that properly constructed wood-frame houses are resistant to shaking damage.

PUBLIC RECORD: Official earthquake fault zone or special study zone maps approved by the State Geologist and issued by the California Department of Conservation, California Geological Survey pursuant to California Public Resources Code §2622.

SEISMIC HAZARD MAPPING ACT ZONE

DISCUSSION: Official Seismic Hazard Zone ("SH Zone") maps delineate Areas of Potential Liquefaction and Areas of Earthquake-Induced Landsliding. A property that lies partially or entirely within a designated SH Zone may be subject to requirements for site-specific geologic studies and mitigation before any new or additional construction may take place.

Earthquake-Induced Landslide Hazard Zones are areas where the potential for earthquake-induced landslides is relatively high. Areas most susceptible to these landslides are steep slopes in poorly cemented or highly fractured rocks, areas underlain by loose, weak soils, and areas on or adjacent to existing landslide deposits. The CGS cautions these maps do not capture all potential earthquake-induced landslide hazards and that earthquake-induced ground failures are not addressed by these maps. Furthermore, no effort has been made to map potential run-out areas of triggered landslides. It is possible that such run-out areas may extend beyond the zone boundaries. An earthquake capable of causing liquefaction or triggering a landslide may not uniformly affect all areas within a SH Zone.

Liquefaction Hazard Zones are areas where there is a potential for, or an historic occurrence of liquefaction. Liquefaction is a soil phenomenon that can occur when loose, water saturated granular sediment within 40 feet of the ground surface, are shaken in a significant earthquake. The soil temporarily becomes liquid-like and structures may settle unevenly. The Public Record is intended to identify areas with a relatively high potential for liquefaction but not to predict the amount or direction of liquefaction-related ground displacement, nor the amount of damage caused by liquefaction. The many factors that control ground failure resulting from liquefaction must be evaluated on a site specific basis.

PUBLIC RECORD: Official seismic hazard maps or digital data thereof approved by the State Geologist and issued by the California Department of Conservation, California Geological Survey pursuant to California Public Resources Code §2696.

STATUTORY NATURAL HAZARD DISCLOSURE REPORTING STANDARD: "IN" shall be reported if any portion of the Property is located within any of the above zones as delineated in the Public Record. "NOT IN" shall be reported if no portion of the Property is located within any of the above zones as delineated in the Public Record. Map Not Available shall be reported in areas not yet evaluated by the governing agency according to the Public Record. Please note that "MAP NOT AVAILABLE" will be applicable to most portions of the state. Official Seismic Hazard Zone ("SH Zone") maps delineate Areas of Potential Liquefaction and Areas of Earthquake-Induced Landsliding.

Part 2. County and City Defined Natural Hazard Zones

HAZARD MAPS IN THE LOCAL GENERAL PLAN

General Plan regulates property development. There are currently over 530 incorporated cities and counties in California. The state Government Code (Sections 65000 et seq.) requires each of those jurisdictions to adopt a comprehensive, long-term "General Plan" for its physical development. That General Plan regulates land uses within the local jurisdiction in order to protect the public from hazards in the environment and conserve local natural resources. The General Plan is the official city or county policy regarding the location of housing, business, industry, roads, parks, and other land uses.

Municipal hazard zones can affect the cost of ownership. Each county and city adopts its own distinct General Plan according to that jurisdiction's unique vegetation, landscape, terrain, and other geographic and geologic conditions. The "Safety Element" (or Seismic Safety Element) of that General Plan identifies the constraints of earthquake fault, landslide, flood, fire and other natural hazards on local land use, and it delineates hazard zones within which private property improvements may be regulated through the building-permit approval process, which can affect the future cost of ownership. Those locally regulated hazard zones are in addition to the federal and state defined hazard zones associated with statutory disclosures in the preceding section.

City and/or County natural hazard zones explained below. Unless otherwise specified, only those officially adopted Safety Element or Seismic Safety Element maps (or digital data thereof) which are publicly available, are of a scale, resolution, and quality that readily enable parcel-specific hazard determinations, and are consistent in character with those statutory federal or state disclosures will be considered for eligible for use as the basis for county- or city-level disclosures set forth in this Report. Please also note:

- If an officially adopted Safety Element or Seismic Safety Element map relies on data which is redundant of that used for state-level disclosures, this Report will indicate so and advise Report recipients to refer to the state-level hazard discussion section for more information.
- If an officially adopted Safety Element or Seismic Safety Element cites underlying maps created by another agency, those maps may be regarded as incorporated by reference and may be used as the basis for parcel-specific determinations if those maps meet the criteria set forth in this section.
- Because county- and city-level maps are developed independently and do not necessarily define or delineate a given hazard the same way, the boundaries for the "same" hazard may be different.

If one or more maps contained in the Safety Element and/or Seismic Safety Element of an officially adopted General Plan are used as the basis for local disclosure, those maps will appear under the "Public Record(s) Searched" for that county or city.

REPORTING STANDARDS

A good faith effort has been made to disclose all hazard features on pertinent Safety Element and Seismic Safety Element maps with well-defined boundaries; however, those hazards with boundaries that are not delineated will be deemed not suitable for parcel-specific hazard determinations. Some map features, such as lines drawn to represent the location of a fault trace, may be buffered to create a zone to facilitate disclosure. Those map features which can not be readily distinguished from those representing hazards may be included to prevent an omission of a hazard feature. If the width of a hazard zone boundary is in question, "IN" will be reported if that boundary impacts any portion of a property. Further explanations concerning specific map features peculiar to a given county or city will appear under the "Reporting Standards" for that jurisdiction.

PUBLIC RECORDS VS. ON-SITE EVALUATIONS

Mapped hazard zones represent evaluations of generalized hazard information. Any specific site within a mapped zone could be at less or more relative risk than is indicated by the zone designation. A site-specific evaluation conducted by a geotechnical consultant or other qualified professional may provide more detailed and definitive information about the Property and any conditions which may or do affect it.

PROPERTY USE AND PERMITTING

No maps beyond those identified as "Public Record(s)" have been consulted for the purpose of these local disclosures. These disclosures are intended solely to make Report recipient(s) aware of the presence of mapped hazards. For this reason -- and because local authorities may use on these or additional maps or data differently to determine property-specific land use and permitting approvals -- Report recipients are advised to contact the appropriate local agency, usually Community Development, Planning, and/or Building, prior to the transaction to ascertain if these or any other conditions or related regulations may impact the Property use or improvement.

ORANGE COUNTY GEOLOGIC ZONES DISCUSSION

PUBLIC RECORD(S) SEARCHED: The following Public Records, incorporated by reference into the Safety Element of the General Plan as adopted by the County Board of Supervisors in 2000, is utilized for those county-level disclosures below: "Environmental Geology of Orange County," a map series prepared by California Geological Survey, Open-File Report 79-8 L.A.

FAULT

- **Active faults (Alquist-Priolo Earthquake Fault Zone):** These faults have evidence of displacement during the most recent epoch of geologic time, the Holocene epoch, generally considered to have begun about 11,000 years ago.
- **Potentially active faults:** These faults show activity within the past 2 million years but show no evidence of movement within the past 11,000 years
- **Inactive faults:** Faults which show no evidence of movement during the past two million years and show no potential for movement in the future.

Reporting Standards: If any portion of the Property is situated within one-eighth of one mile (660 feet) of a fault trace as delineated in the Public Record, "WITHIN" shall be reported.

DEBRIS FLOW, MUD FLOW, AND ROCKFALL

Areas of potential mud and/or debris flow may occur during periods of exceptionally high rainfall. Rockfall zones may experience falling rocks during periods of exceptionally high rainfall or seismic shaking.
Reporting Standards: If any portion of the Property is within a Mud Flow Zone as delineated in the Public Record,, "IN" shall be reported. If any portion of the Property is within a Rockfall Zone as delineated in the Public Record, "IN" shall be reported.

LIQUEFACTION POTENTIAL

Liquefaction is a liquid-like condition of the soil which sometimes occurs during earthquake shaking where the ground water level is close to the surface and the subsurface materials are loose and cohesionless (such as sandy soil). These factors have the potential to combine to produce liquefaction in local areas.
Reporting Standards: If any portion of the Property is within a Liquefaction Zone as delineated in the Public Record, "IN" shall be reported.

SEISMIC SHAKING

Several seismic zones have been defined by Orange County to separate areas having varying responses to earthquake shaking. The zones were defined utilizing a variety of geologic, hydrologic and slope gradient information, but by necessity, have been generalized. Any single property within a Seismic Zone could be at less or more relative risk than is indicated by the zone designation. If site-specific information regarding seismic hazards is desired, this company recommends that a geotechnical consultant be retained to study the site.

- **Seismic Shaking Zone A:** Zone A represents areas of least earthquake shaking. The maximum expected damage to modern construction due to shaking is expected to be minor to moderate in this zone.
- **Seismic Shaking Zone B:** Zone B represents areas of intermediate earthquake shaking. The maximum expected damage to modern construction due to shaking is expected to be moderate in this zone.
- **Seismic Shaking Zone C:** These are areas of high geologic hazard only if strong earthquake shaking produces liquefaction.

Reporting Standards: If any portion of the Property is within a Seismic Shaking Zone as delineated in the Public Record, only the more/most severe shall be reported.

TSUNAMI

This area has been designated as a zone of moderate risk for tsunami (seismic sea wave or "tidal wave ") run-up. Properties in a tsunami zone may be inundated with waves which recur on the average of once every 100 years.
Reporting Standards: If any portion of the Property is within a Tsunami Run-up Zone as delineated in the Public Record, "IN" shall be reported.

LANDSLIDE / SLOPE STABILITY ZONES

The relative slope stability zones represent average slope stability conditions. This Report discloses Slope Stability Zone for conditions under seismic (earthquake) conditions, not aseismic (normal) conditions, as detailed in the Public Record.

- **Zone 1: Very low potential** for massive bedrock landslides under normal and seismic/earthquake conditions.
- **Zone 2: Moderately low potential** for massive bedrock landslides under seismic/earthquake conditions.
- **Zone 3: Moderately high potential** under seismic/earthquake conditions with a greater slope failure risk during earthquakes if the slope gradient is greater than 20% and the slope is underlain by relatively weak bedrock or weak soil materials.
- **Zone 4: High potential** for massive bedrock landslides under seismic/earthquake conditions.
- **Zones 5 and 6: Very high potential** for massive bedrock landslides under seismic/earthquake conditions.

- **Zone W:** Coastal areas which have unstable slopes resulting from periodic wave erosion. Please note that the boundaries of this Slope Stability Area W are not defined in a manner suitable for definitive parcel-specific disclosure; therefore, this zone is not disclosed in this Report.

Reporting Standards: "Very High, High, or Moderate" shall be reported if any portion of the Property is within Slope Stability Zone 3, 4, 5, or 6. "Moderately Low or Low" shall be reported in the Property is completely within Slope Stability Zone 1 or 2.

EXPANSIVE SOILS

Expansive soils occur throughout much of Orange County. These areas are subject to the seasonal shrink-swell cycles of soils, as well as slope yielding if locally on a slope. Three possible conditions related to expansive soils exist in the County.

- **Differential Swell** is the uneven tilting or lifting of a structure by the greater expansion of thicker soils on one side of the structure.
- **Concentric Swell** is caused by the migration of water toward the center of a structure, causing expansion of the soils, and lifting of the center of the structure.
- **Slope Yielding** is a slow down slope movement of soils, causing tilting of the foundation of a structure. Experts agree that no residence is completely safe from cracking, slipping or sinking to some degree.

Expansive soil problems can be mitigated, in most cases, through structural and design modifications and, in some cases, through soil treatment techniques. Mapped areas of expansive soils are identified as:

- **Areas of Man Made Land with Extremely Variable Expansivity Potential**
- **Areas of High Expansivity Potential**
- **Areas of Tidal Flats with Highly Variable Expansivity or Shrink Potential**
- **Areas of Moderate Expansivity Potential**
- **Areas of Low Expansivity Potential**

Reporting Standards: If any portion of the Property is within an area of Low, Moderate, or High Expansivity Potential or is within a Tidal Flat as delineated in the Public Record, "IN" shall be reported for the more/most severe condition.

CITY OF LAKE FOREST GEOLOGIC ZONES DISCUSSION

PUBLIC RECORD(S) SEARCHED: The following Public Record, incorporated into the Safety and Noise Element of the General Plan as adopted by the City Council in 1994, are used for those city-level disclosures below: " Figure SN-3: Area of Fire Hazard " prepared by Cotton/Beland/Associates, Inc.

FIRE

According to the General Plan the City's Planning Area is subject to both wild and urban fires. The eastern portion is contiguous with the Cleveland National Forest. Regional natural vegetation is highly prone to wild fire. A fire in the national forest could spread to developed areas. The urbanized portion of the Planning Area is also subject to structural fires. The City will reduce the potential for dangerous fires by coordinating with the Orange County Fire Department to implement fire hazard education, fire protection, and fuel modification programs. The current Uniform Fire Code will be used to reduce structural fire hazards. In addition, the City will work closely with the local water districts and the Orange County Fire Department to ensure that water pressure is adequate for firefighting purposes.

Reporting Standards: If any portion of the Property is within the Fire Hazard Area delineated in the Public Record, "IN" shall be reported.

END OF LOCAL AREA DISCLOSURES AND DISCUSSIONS SECTION

The Natural Hazard Disclosure Report
For ORANGE County

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Part 3. Additional Property Specific Disclosures

FORMER MILITARY ORDNANCE SITE DISCLOSURE

DISCUSSION: Former Military Ordnance (FUD) sites can include sites with common industrial waste (such as fuels), ordnance or other warfare materiel, unsafe structures to be demolished, or debris for removal. California Civil Code Section 1102 requires disclosure of those sites containing unexploded ordnance. "Military ordnance" is any kind of munitions, explosive device/material or chemical agent used in military weapons. Unexploded ordnance are munitions that did not detonate. NOTE: **MOST** FUD sites do not contain unexploded ordnance. Only those FUD sites that the U.S. Army Corps of Engineers (USACE) has identified to contain Military Ordnance or have mitigation projects planned for them are disclosed in this Report. Additional sites may be added as military installations are released under the Federal Base Realignment and Closure (BRAC) Act. Active military sites are NOT included on the FUD site list.

PUBLIC RECORD: Data contained in Inventory Project Reports, Archives Search Reports, and related materials produced for, and made publicly available in conjunction with, the Defense Environmental Restoration Program for Formerly Used Defense Sites by the U.S. Army Corps of Engineers. Sites for which no map has been made publicly available shall not be disclosed.

REPORTING STANDARD: If one or more facility identified in the Public Record is situated within a one (1) mile radius of the Property, "**WITHIN**" shall be reported. The name of that facility or facilities shall also be reported.

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AIRPORT INFLUENCE AREA DISCLOSURE

DISCUSSION:
Certain airports are not disclosed in this Report. FANHD has made a good faith effort to identify the airports covered under Section 1102.6a. Sources consulted include official land use maps and/or digital data made available by a governing Airport Land Use Commission (ALUC) or other designated government body. Most facilities for which an Airport Influence Area has been designated are included on the "California Airports List" maintained by the California Department of Transportation's Division of Aeronautics. Not disclosed in this Report are public use airports that are not in the "California Airports List", airports that are physically located outside California, heliports and seaplane bases that do not have regularly scheduled commercial service, and private airports or military air facilities unless specifically identified in the "California Airports List". **If the seller has actual knowledge of an airport in the vicinity of the subject property that is not disclosed in this Report, and that is material to the transaction, the seller should disclose this actual knowledge in writing to the buyer.**

Most facilities for which an Airport Influence Area has been designated are included on the "California Airports List" maintained by the California Department of Transportation's Division of Aeronautics. The inclusion of military and private airports varies by County, and heliports and seaplane bases are not included, therefore, airports in these categories may or may not be included in this disclosure.

NOTE: Proximity to an airport does not necessarily mean that the property is exposed to significant aviation noise levels. Alternatively, there may be properties exposed to aviation noise that are greater than two miles from an airport. Factors that affect the level of aviation noise include weather, aircraft type and size, frequency of aircraft operations, airport layout, flight patterns or nighttime operations. Buyer should be aware that aviation noise levels can vary seasonally or change if airport usage changes.

PUBLIC RECORD: Based on officially adopted land use maps and/or digital data made publicly available by the governing ALUC or other designated government body. If the ALUC or other designated government body has not made publicly available a current officially adopted airport influence area map, then California law states that "a written disclosure of an airport within two (2) statute miles shall be deemed to satisfy any city or county requirements for the disclosure of airports in connection with transfers of real property."

REPORTING STANDARD: "**IN**" shall be reported along with the facility name(s) and the "Notice of Airport in Vicinity" if any portion of the Property is situated within either (a) an Airport Influence Area as designated on officially adopted maps or digital data or (b) a two (2) mile radius of a qualifying facility for which an official Airport Influence Area map or digital data has not been made publicly available by the ALUC or other designated governing body. "**NOT IN**" shall be reported if no portion of the Property is within either area.

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AIRPORT NOISE DISCLOSURE

DISCUSSION: California Civil Code §1102.17 requires the seller(s) of residential real property who has/have actual knowledge that the property in the transaction is affected by airport use must give written notice of that knowledge, as soon as practicable, before transfer of title.

Under the Federal Aviation Administration's *Airport Noise Compatibility Planning Program Part 150*, certain 65 decibel (dB) Community Noise Equivalent Level (CNEL) contour maps have been produced for some airports. Not all airports have produced noise exposure maps. A property may be near or at some distance from an airport and not be within a delineated noise exposure area, but still experience aviation noise. Unless 65dB CNEL contour maps are published, helipads and military sites are not included in this section of the Report.

The *Airport Noise Compatibility Planning Program* is voluntary and not all airports have elected to participate. Furthermore, not all property in the vicinity of an airport is exposed to 65dB CNEL or greater average aviation noise levels. Conversely a property may be at some distance from an airport and still experience aviation noise. Buyer should be aware that aviation noise levels can vary seasonally or change if airport usage changes after a map is published or after the Report Date. FANHD uses the most seasonally conservative noise exposures provided.

Federal funding may be available to help airports implement noise reduction programs. Such programs vary and may include purchasing properties, rezoning, and insulating homes for sound within 65dB areas delineated on CNEL maps. Airport owners have also cooperated by imposing airport use restrictions that include curfews, modifying flight paths, and aircraft limitations.

PUBLIC RECORD: Certain 65 decibel (dB) Community Noise Equivalent Level (CNEL) contour maps produced under the Federal Aviation Administration's *Airport Noise Compatibility Planning Program Part 150*.

REPORTING STANDARD: "**IN**" shall be reported if any portion of the Property is situated within a 65 decibel Community Noise Equivalent Level contour identified in the Public Record. "**NOT IN**" shall be reported if no portion of the Property is situated within a 65 decibel Community Noise Equivalent Level contour identified in the Public Record.

Part 4. General Advisories

METHAMPHETAMINE CONTAMINATED PROPERTY DISCLOSURE ADVISORY

DISCUSSION: According to the "Methamphetamine Contaminated Property Cleanup Act of 2005" a property owner must disclose in writing to a prospective buyer if local health officials have issued an order prohibiting the use or occupancy of a property contaminated by meth lab activity. The owner must also give a copy of the pending order to the buyer to acknowledge receipt in writing. Failure to comply with these requirements may subject an owner to, among other things, a civil penalty up to $5,000. Aside from disclosure requirements, this new law also sets forth procedures for local authorities to deal with meth-contaminated properties, including the filing of a lien against a property until the owner cleans up the contamination or pays for the cleanup costs.

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MOLD ADVISORY

DISCUSSION: The Buyer is hereby advised that naturally occurring molds may exist both inside and outside of any home and may not be visible to casual inspection. Persons exposed to extensive mold levels can become sensitized and develop allergies to the mold or other health problems. Extensive mold growth can damage a structure and its contents. All prospective purchasers of residential and commercial property are advised to thoroughly inspect the Property for mold. Be sure to inspect the Property inside and out for sources of excess moisture, current water leaks and evidence of past water damage.

As part of a buyer's physical inspection of the condition of a property, the buyer should consider engaging an appropriate and qualified professional to inspect and test for the presence of harmful molds and to advise the buyer of any potential risk and options available. This advisory is not a disclosure of whether harmful mold conditions exist at a property or not. No testing or inspections of any kind have been performed by The Company. Any use of this form is acknowledgement and acceptance that The Company does not disclose, warrant or indemnify mold conditions at a property in any way and is not responsible in any way for mold conditions that may exist. Information is available from the California Department of Health Services Indoor Air Quality Section fact sheet entitled, "Mold in My Home: What Do I Do?" The fact sheet is available at https://archive.cdph.ca.gov/programs/IAQ/Pages/IndoorMold.aspx or by calling (510) 620-3620.

The Toxic Mold Protection Act of 2001 requires that information be developed regarding the potential issues surrounding naturally occurring molds within a home. Information was written by environmental authorities for inclusion in the *Residential Environmental Hazards: A Guide for Homeowners, Buyers, Landlords and Tenants* booklet developed by the California Environmental Protection Agency and the Department of Health Services. It is found in Chapter VII of that booklet, and includes references to sources for additional information.

For local assistance, contact your county or city Department of Health, Housing, or Environmental Health.

RADON ADVISORY

DISCUSSION: For its Radon Advisory, FANHD uses the updated assessment of radon exposure published in 1999 by the Lawrence Berkeley National Laboratory (LBNL) and Columbia University, under support from the U.S. Environmental Protection Agency (EPA), the National Science Foundation, and the US Department of Energy (published online at http://www2.lbl.gov/Science-Articles/Archive/radon-risk-website.html). Based on this recent assessment, FANHD radon advisory is as follows:

All of California's 58 counties have a predicted median annual-average living-area concentration of radon below 2.0 pCi/L (picocuries per liter of indoor air) -- which is well below the EPA's guideline level of 4 pCi/L and equivalent to the lowest hazard zone (Zone 3) on the 1993 EPA Map of Radon Zones.

The "median concentration" means that half of the homes in a county are expected to be below this value and half to be above it. All houses contain some radon, and a few houses will contain much more than the median concentration. **The only way to accurately assess long-term exposure to radon in a specific house is through long-term testing (sampling the indoor air for a year or more). The EPA recommends that all homes be tested for radon.** Columbia University's "Radon Project" website offers help to homeowners in assessing the cost vs. benefit of testing a specific house for radon or modifying it for radon reduction (see http://www.stat.columbia.edu/~radon/).

NOTE: FANHD does not use the EPA's 1993 map for advisory purposes because that map shows "short-term" radon exposure averaged by county. It was based on "screening measurements" that were intentionally designed to sample the worst-case conditions for indoor air in US homes--using spot checks (sampling for just a few days), in the poorest air quality (with sealed doors and windows), at the worst time of the year (winter), in the worst part of the house (the basement, if one was available). These short-term, winter, basement measurements are both biased and variable compared to long-term radon concentrations (averaged over a year) in the living area of a house. Long-term concentrations are a more accurate way to judge the long-term health risk from radon. For the above reasons, the EPA expressly disclaims the use of its 1993 map for determining whether any house should be tested for radon, and authorizes no other use of its map for property-specific purposes. For additional information about EPA guidelines and radon testing, see "Chapter VII--Radon", in the California Department of Real Estate's *Residential Environmental Hazards: A Guide for Homeowners, Homebuyers, Landlords and Tenants*.

ENDANGERED SPECIES ACT ADVISORY

DISCUSSION: The Federal Endangered Species Act of 1973 ("ESA"), as amended, requires that plant and animal species identified and classified ("listed") by the Federal government as "threatened" or "endangered" be protected under U.S. law. Areas of habitat considered essential to the conservation of a listed species may be designated as "critical habitat" and may require special management considerations or protection. All threatened and endangered species -- even if critical habitat is not designated for them -- are equally afforded the full range of protections available under the ESA.

In California alone, over 300 species of plants and animals have been designated under the ESA as threatened or endangered, and over 80 species have critical habitats designated for them. Most California counties are host to a dozen or more protected species and, in many cases, 10 or more species have designated critical habitats within a county.

ADVISORY: An awareness of threatened and endangered species and/or critical habitats is not reasonably expected to be within the actual knowledge of a seller.

No federal or state law or regulation requires a seller or seller's agent to disclose threatened or endangered species or critical habitats, or to otherwise investigate their possible existence on real property. Therefore, Buyer is advised that, prior to purchasing a vacant land parcel or other real property, Buyer should consider investigating the existence of threatened or endangered species, or designated critical habitats, on or in the vicinity of the Property which could affect the use of the Property or the success of any proposed (re)development.

FOR MORE INFORMATION: Complete and current information about the threatened and endangered species in California that are Federally listed in each county -- including all critical habitats designated there -- is available on the website of the U.S. Fish & Wildlife Service, the Federal authority which has enforcement responsibility for the ESA.

U.S. Fish & Wildlife Service Endangered Species Database (TESS)
http://ecos.fws.gov/tess_public/

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ABANDONED MINES ADVISORY

DISCUSSION: According to the California Department of Conservation, Office of Mine Reclamation, since the Gold Rush of 1849, tens of thousands of mines have been dug in California. Many were abandoned when they became unproductive or unprofitable. The result is that California's landscape contains many thousands of abandoned mines, which can pose health, safety, or environmental hazards on and around the mine property. Mines can present serious physical safety hazards, such as open shafts or adits (mine tunnel), and they may create the potential to contaminate surface water, groundwater, or air quality. Some abandoned mines are such massive problems as to earn a spot on the Federal Superfund environmental hazard list.

No California law requires the disclosure of abandoned mines in a real estate transaction, unless the existence of an abandoned mine is within the actual knowledge of the Seller and is deemed to be a fact material to the transaction.

The Office of Mine Reclamation (OMR) and the U.S. Geological Survey maintain a database of abandoned mines -- however, it is known to be incomplete and based on maps that are often decades out of date. Many mines are not mapped because they are on private land. The OMR warns that, ***"Many old and abandoned mines are not recorded in electronic databases, and when they are, the information may not be detailed enough to accurately define, differentiate or locate the mine feature, such as a potentially hazardous vertical shaft or horizontal adit or mine waste." (See reference below.)***

Accordingly, this Report does not contain an abandoned mines disclosure from any government database or map or any other source, in order to protect the seller from liability for non-disclosure of unrecorded abandoned mines.

Parties concerned about the possible existence or impact of abandoned mines in the vicinity of the Property are advised to retain a State-licensed geotechnical consultant to study the site and issue a report. Other sources of information include, but are not limited to, the State Office of Mine Reclamation at (916) 323-9198 (website: http://www.conservation.ca.gov/OMR), and the Engineering, Planning or Building Departments in the subject City and County.

FOR MORE INFORMATION: For more information visit the State Office of Mine Reclamation's website at:
http://www.conservation.ca.gov/omr/abandoned_mine_lands/Pages/index.aspx

OIL & GAS WELL ADVISORY

California is currently ranked fourth in the nation among oil producing states. Surface oil production is concentrated mainly in the Los Angeles Basin and Kern County, and in districts elsewhere in the state. In recent decades, real estate development has rapidly encroached into areas where oil production has occurred. Because the state's oil production has been in decline since the 1980's, thousands of oil and gas wells have been shut down or abandoned, and many of those wells are in areas where residential neighborhoods now exist.

According to the California Department of Conservation ("DOC"), to date, about 230,000 oil and gas wells have been drilled in California and around 105,000 are still in use. The majority of remaining wells have been sealed ("capped") under the supervision of the DOC's Division of Oil, Gas and Geothermal Resources. A smaller number have been abandoned and have no known responsible operator -- these are called "orphan" wells. The state has a special fund that pays the cost of safely capping orphan wells, however, that program is limited in its scope and progress.

Buyer should be aware that, while the DOC database is the most comprehensive source available for California oil and gas well information, the DOC makes no warranties that the database is absolutely complete, or that reported well locations are known with absolute accuracy.

For More Information
For a search of the state's databases of oil and gas wells and sites of known environmental contamination on or near the Property, please obtain the FANHD Residential Environmental Report. For general information, visit the California Department of Conservation, Division of Oil, Gas, and Geothermal Resources at http://www.consrv.ca.gov/dog.

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TSUNAMI MAP ADVISORY

DISCUSSION: The California Emergency Management Agency (CalEMA), the University of Southern California Tsunami Research Center (USC), and the California Geological Survey (CGS) have prepared maps that depict areas of maximum tsunami inundation for all populated areas at risk to tsunamis in California (20 coastal counties). The maps were publicly released in December 2009 with the stated purpose that the maps are to assist cities and counties in identifying their tsunami hazard and developing their coastal evacuation routes and emergency response plans only.

These maps specifically contain the following disclaimer:

Map Disclaimer: This tsunami inundation map was prepared to assist cities and counties in identifying their tsunami hazard. It is intended for local jurisdictional, coastal evacuation planning uses only. This map, and the information presented herein, ***is not a legal document and does not meet disclosure requirements for real estate transactions nor for any other regulatory purpose.*** The California Emergency Management Agency (CalEMA), the University of Southern California (USC), and the California Geological Survey (CGS) make no representation or warranties regarding the accuracy of this inundation map nor the data from which the map was derived. Neither the State of California nor USC shall be liable under any circumstances for any direct, indirect, special, incidental or consequential damages with respect to any claim by any user or any third party on account of or arising from the use of this map.

A tsunami is a series of ocean waves or surges most commonly caused by an earthquake beneath the sea floor. These maps show the maximum tsunami inundation line for each area expected from tsunamis generated by undersea earthquakes and landslides in the Pacific Ocean. Because tsunamis are rare events in the historical record, the maps provide no information about the probability of any tsunami affecting any area within a specific period of time.

Although these maps may not be used as a legal basis for real estate disclosure or any other regulatory purpose, the CGS has, however, provided diagrams of the maps online which the public can view. To see a maximum tsunami inundation map for a specific coastal community, or for additional information about the construction and/or intended use of the tsunami inundation maps, visit the websites below:

State of California Emergency Management Agency, Earthquake and Tsunami Program:
http://myhazards.calema.ca.gov/

University of Southern California -- Tsunami Research Center:
http://www.usc.edu/dept/tsunamis/2005/index.php

State of California Geological Survey Tsunami Information:
http://www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/index.htm

National Oceanic and Atmospheric Agency Center for Tsunami Research (MOST model):
http://nctr.pmel.noaa.gov/time/background/models.html

END OF NATURAL HAZARD DISCLOSURE REPORT SECTION
See Terms and Conditions at end of this Report.

Property Address: VACANT AND 20865 CANADA RD
LAKE FOREST, ORANGE COUNTY, CA 92630
("Property")

APN: See Addendum
Report Date: 01/25/2019
Report Number: 2419042

TERMS and CONDITIONS

ACCEPTANCE OR USE OF THIS REPORT CONSTITUTES APPROVAL AND ACCEPTANCE OF THE TERMS, CONDITIONS, AND LIMITATIONS STATED HEREIN.

The Report ("Report") is subject to each of the following Terms and Conditions. Each Recipient (defined below) of the Report agrees that the Report is subject to the following Terms and Conditions, and each Recipient agrees to be bound by such. Use of this Report by any Recipient constitutes acceptance of the Terms and Conditions to the Report. The Terms and Conditions below are incorporated by this reference into the Report. **This Report is not an insurance policy.**

This Report is made for the real property specifically described in the Report (the "Property") and solely for the transaction for which it was originally purchased ("Transaction"). The Property shall not include any property beyond the boundaries of the real property described in the Report. The Property shall not include any structures (whether located on the Property, or not), easements, or any right, title, interest, estate, or easement in any abutting streets, roads, alleys, lanes, ways, or waterways.

IMPORTANT NOTICE: Transferor(s) and transferee(s) shall read the complete Report in its entirety before the close of escrow. A "Signature Page" or "Summary Pages" document may be included in the electronic delivery of this Report. Those documents do not replace the complete Report or remove the need to read the complete Report, and do not remove the requirement to disclose. The Signature Page and Summary Pages documents are subject to the Terms and Conditions of the complete Report.

A. **No Third Party Reliance on This Report.** Only the transferor(s) and transferee(s), and their agents/brokers, if any, involved in the Transaction (collectively, the "Recipients") may use and rely on this Report and only after they have paid in full for the Report. While disclosures made on the Natural Hazard Disclosure Statement in the Report may indicate certain risks to the Property, the disclosures are only "…between the transferor, the transferor's agents, and the transferee, and shall not be used by any other party, including, but not limited to, insurance companies, lenders, or governmental agencies, for any purpose." Cal. Civil Code section 1103.2, subdivision (g).

B. **Seller and Seller's Agent's Responsibility of Full Disclosure.** Recipients are obligated to make disclosures, and always disclose material facts, that are within their actual knowledge.

C. **Scope of Report.** This Report is limited to determining whether the Property is in those specified natural hazard zones and property tax districts, and in proximity to those specified environmental sites (depending on the report product ordered), as defined in the Report. The Report is not a geologic report or a land survey and no site inspection has been made in producing the Report. FANHD makes no determination, expresses no opinion or view, and assumes no responsibility in this Report concerning the right, entitlement, or ability to develop or improve the Property. FANHD has no information concerning whether the Property can be developed or improved. No determination is made and no opinion is expressed, or intended, by this Report concerning structures or soils on or outside of the Property, including, without limitation, habitability of structures or the Property, suitability of the Property for construction or improvement, potential for soil settlement, drainage, soil subsidence, or other soil or site conditions. The Recipient(s) is advised to consult the local Planning Department to determine whether factors beyond the scope of this Report may limit the transferee(s) ability to use or improve the Property.

   The Report is not a title report, and no determination is made and no opinion is expressed, or intended, by this Report as to title to the Property or liens against the Property, recorded or otherwise, or whether the Property is comprised of legal lots in conformance with the California Subdivision Map Act or local ordinances. The Report is not a property inspection report, and no determination is made and no opinion is expressed, or intended, by this Report concerning architectural, structural, mechanical, engineering, or legal matters, or the marketability or value of the Property. FANHD has not conducted any testing or physical or visual examination or inspection of the Property, nor is this Report a substitute for any such testing, physical or visual examination, or inspection.

D. **Tax and Environmental Disclosures (if included in Report).** No determination is made and no opinion is expressed, or intended, by the Report concerning the existence of property tax liabilities, or the existence of hazardous or toxic materials or substances, or any other defects, on, under, or in proximity to the Property, unless specifically described in the Report. FANHD's total liability for any error or omission in its disclosures relating to taxes and/or environmental matters shall be limited to actual proven damages not to exceed the price paid for this Report.

E. **FANHD Database Updates.** Each database used in this Report is updated by the responsible agency at various intervals. Updates for a database are determined by the responsible agency and may be made at any time and without notice. FANHD maintains an update schedule and makes reasonable efforts to use updated information. For these reasons, FANHD reports information as of the date when the database was last updated by FANHD. That date is specified as the "Database Date" for each database.

F. **Statutory and Additional Disclosures, Advisories, and Local Addenda (if included in Report).** No determination is made and no opinion is expressed, or intended, by this Report concerning the need to purchase earthquake or flood insurance for the Property. In preparing the Report, FANHD accurately reported on information contained in Government Records. FANHD reviewed and relied upon those Government Records specifically identified and described in the Report. FANHD has not reviewed or relied upon any Government Records that are not specifically identified in the Report. FANHD also has not reviewed any plat maps, survey maps, surveyor maps, assessor maps, assessor parcel maps, developer maps, or engineering maps, whether or not such maps have been recorded. No determination is made and no opinion is expressed, or intended, by the Report concerning any matters identified in Government Records that were not reviewed by FANHD. Local Addenda, where applicable, are included "AS IS" as an accommodation to the local real estate board that provided the content; FANHD assumes no responsibility for the accuracy of any information included in the Local Addenda.

G. **FEMA Flood Determination Certificate (if accompanying the Report).** No determination is made and no opinion is expressed, or intended, by the Report concerning the requirement for or cost of flood insurance on the Property. Recipient(s) understands that a lender may require flood insurance to secure its loan collateral independent of whether FEMA may require flood insurance under the National Flood Insurance Program on a federally backed mortgage. The FEMA Flood Determination Certificate ("Flood Certificate"), which may accompany the Report, is produced by a third-party expert certified by FEMA to provide Flood Certificates. FANHD assumes no liability for errors in that third-party flood determination.

H. **Changes to Government Record after Report Date.** This Report is issued as of the Report Date identified in the Report. FANHD shall have no obligation to advise any Recipient of any information learned or obtained after the Report Date even if such information would modify or otherwise affect the Report. Subsequent to FANHD acquisition of Government Records, changes may be made to said Government Records and FANHD is not responsible for advising the Recipients of any changes. FANHD will update this Report upon request and at no charge during the transaction process for which this Report was issued, but not to exceed one year from the date of the Report. Likewise, FANHD is not liable for any impact on the Property that any change to the Government Records may have.

Property Address: VACANT AND 20865 CANADA RD
LAKE FOREST, ORANGE COUNTY, CA 92630
("Property")

APN: See Addendum
Report Date: 01/25/2019
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I. **Government Record Sources.**FANHD relies upon the Government Records specifically identified in the Report without conducting an independent investigation of their accuracy. FANHD assumes no responsibility for the accuracy of the Government Records identified in the Report. FANHD makes no warranty or representation of any kind, express or implied, with respect to the Report. FANHD expressly disclaims and excludes any and all other express and implied warranties, including, without limitation, warranties of merchantability or fitness for a particular purpose. The FANHD Report is "AS IS".

J. **Limitation of FANHD's Liability**

1. FANHD is not responsible for:
   - Any inaccuracies or incompleteness of the information in the Public Records.
   - Inaccurate address information provided for the Property.
   - Any other information not contained in the Public Records as of the Report Date.
   - Any information which would be disclosed by a physical inspection of the Property.
   - Any information known by one of the Parties.
   - The health or risk to humans or animals that may be associated with any of the disclosed hazards.
   - The costs of investigating or remediating any of the disclosed hazards.
2. FANHD's total liability and responsibility to all Recipients collectively for any and all liabilities, causes of action, claim or claims, including but not limited to claims for breach of contract or negligence, shall be limited to the price paid for the Report. FANHD expressly disclaims any liability for Recipients indirect, incidental and/or consequential damages, including without limitation lost profits even if such damages are foreseeable. In the event of any error, omission or inaccuracy in the FANHD Report for which FANHD is liable, FANHD shall have no duty to defend or pay any attorneys' fees, costs or expenses incurred by the Recipients, or any of them. The Recipients, and each of them, expressly waive the benefits of California Civil Code Section 2778. FANHD has not conducted an independent investigation of the accuracy of the information provided by the Recipient. FANHD assumes no responsibility for the accuracy of information provided by the Recipient. FANHD shall be subrogated to all rights of any claiming party against anyone including, but not limited to, another party who had actual knowledge of a matter and failed to disclose it to the Recipients in writing prior to the close of escrow.

K. **Reporting of Risk Elements for Condominium Projects, Planned Unit Developments, and Other Properties with Common or Undivided Interests.** Because California's Residential Natural Hazard Disclosure Law requires disclosure if any portion of the Property is located within a specified natural hazard area/zone, the Report must indicate that the subject Property falls within the area/zone if any portion of such a condominium project, planned unit development, or common area is located within a specified hazard area/zone. However, if the property owner has a shared interest in common area or other parcels which extend beyond the subject property's parcel boundary, the Company is not always able to determine if the common area is within a special natural hazard area/zone. Consult with the property's home owners association(s) to determine said risk and responsibility.

L. **Governing Law.** The Report shall be governed by, and construed in accordance with, the laws of the State of California.

M. **Small Claims or Arbitration.** This provision constitutes an agreement to arbitrate disputes on an individual basis. Any party may bring an individual action in small claims court instead of pursuing arbitration. All disputes and claims arising out of or relating to the Report must be resolved by binding arbitration. This Report to arbitrate includes, but is not limited to, all disputes and claims between FANHD, transferor(s) and transferee(s) and claims that arose prior to purchase of the Report. This agreement to arbitrate applies to transferor(s) and transferee(s) successors in interest, assigns, heirs, spouses, and children. As noted above, a party may elect to bring an individual action in small claims court instead of arbitration, so long as the dispute falls within the jurisdictional requirements of small claims court.

Any arbitration must take place on an individual basis, FANHD, transferor(s) and transferee(s) agree that they are waiving any right to a jury trial and to bring or participate in a class, representative, or private attorney general action, and further agree that the arbitrator lacks the power to consider claims for injunctive or declaratory relief, or to grant relief effecting anyone other than the individual claimant.

The arbitration is governed by the Commercial Arbitration Rules and the Supplementary Procedures for Consumer Related Disputes (the "AAA Rules") of the American Arbitration Association ("AAA"), as modified by this Agreement, and will be administered by the AAA. Company will pay all AAA filing, administration and arbitrator fees for any arbitration it initiates and for any arbitration initiated by another party for which the value of the claims is $75,000 or less, unless an arbitrator determines that the claims have been brought in bad faith or for an improper purpose, in which case the payment of AAA fees will be governed by the AAA Rules. **A COPY OF THESE RULES IS AVAILABLE FROM THE AAA'S WEB SITE AT WWW.ADR.ORG OR ON REQUEST FROM THE COMPANY. THE ARBITRATION AWARD MAY INCLUDE ATTORNEY'S FEES IF ALLOWED BY FEDERAL, STATE, OR OTHER APPLICABLE LAW AND MAY BE ENTERED AS A JUDGMENT IN ANY COURT OF PROPER JURISDICTION.**

The arbitration will take place in the same county in which the property covered by the Report is located. The Federal Arbitration Act will govern the interpretation, applicability and enforcement of this arbitration agreement. This arbitration agreement will survive the termination of this Report.

N. **Severability.** If any provision of the Terms and Conditions to this Report is determined to be invalid or unenforceable for any reason, then such provision shall be treated as severed from the remainder of the Terms and Conditions, and shall not affect the validity and enforceability of all of the other provisions of the Terms and Conditions.

O. **Other Agreements.** This Report constitutes the entire, integrated agreement between FANHD and Recipients, and supersedes and replaces all prior statements, representations, negotiations, and agreements.

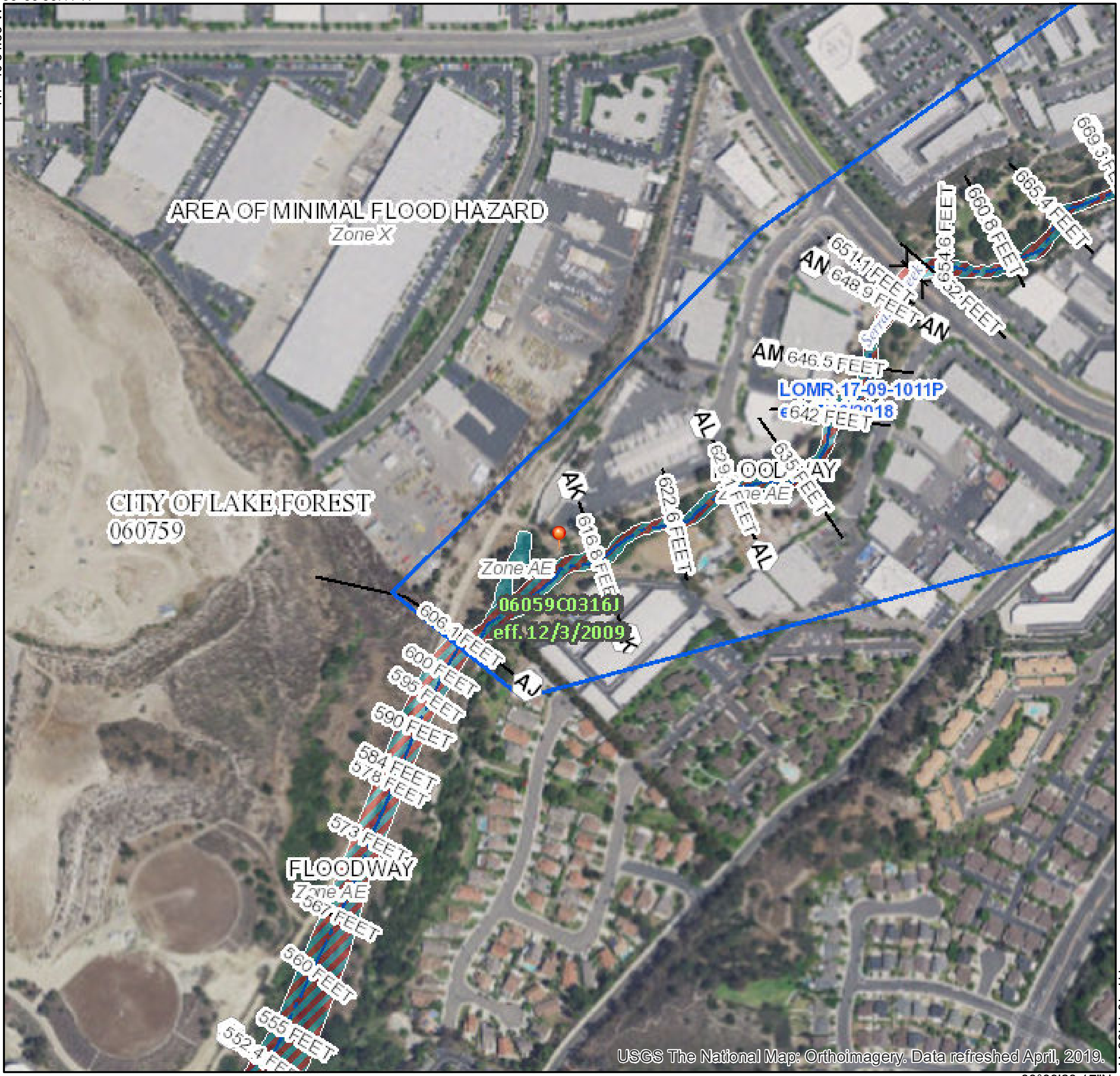
END OF REPORT

National Flood Hazard Layer FIRMette

FEMA

33°39'53.11"N

117°40'54.83"W



117°40'17.38"W

33°39'23.17"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

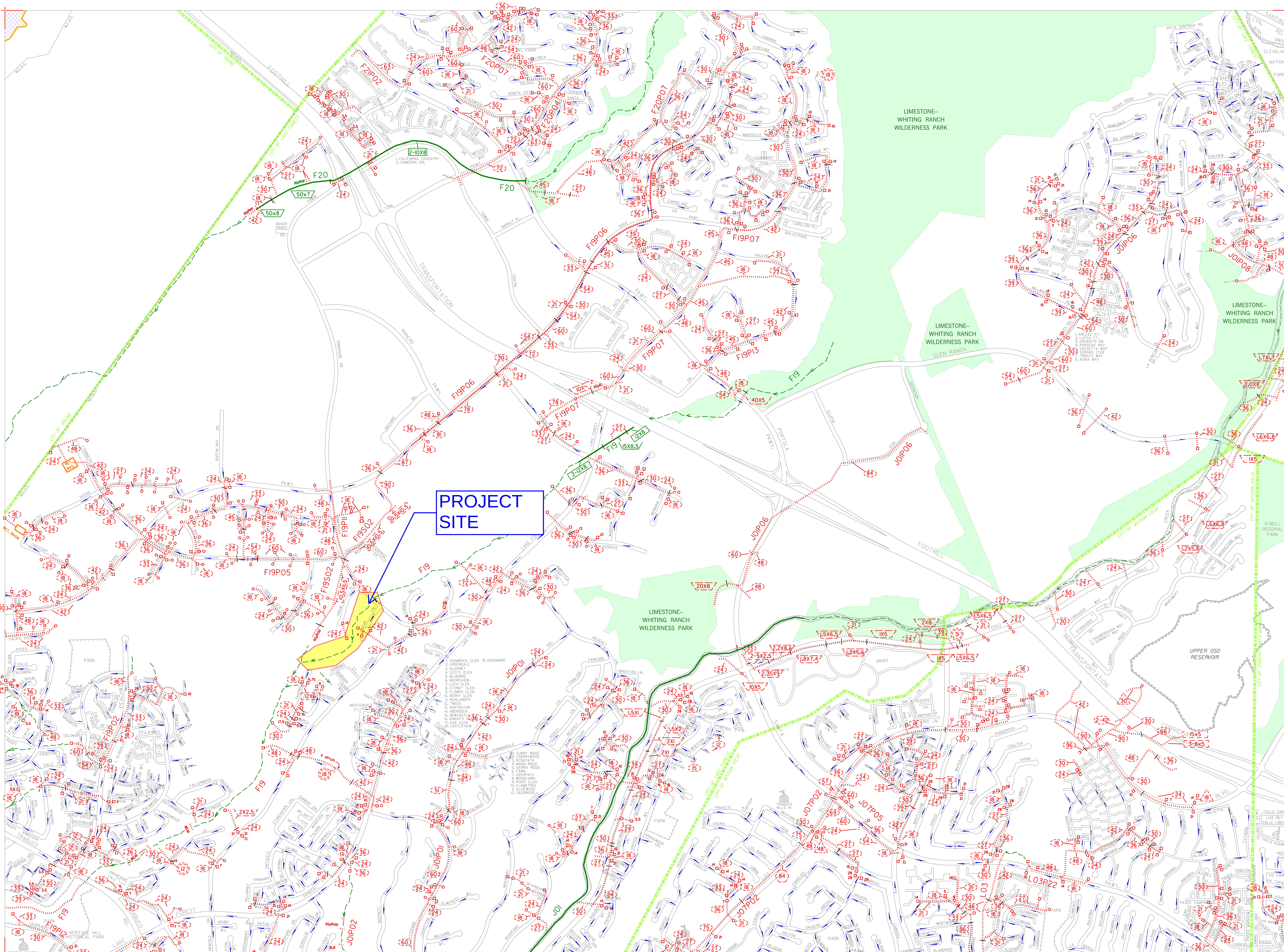
N

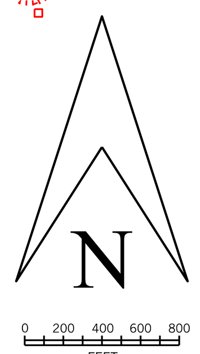
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/9/2019 at 11:22:33 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.





NOTICE

The drainage information has been prepared for information purposes only. The location, ownership, facility information and limits have been determined from available information provided by public agencies, but may not be exact, accurate, or up–to–date. The user of this information is responsible for verifying exact location, ownership, accuracy, and the regional versus local character of drainage facilities.

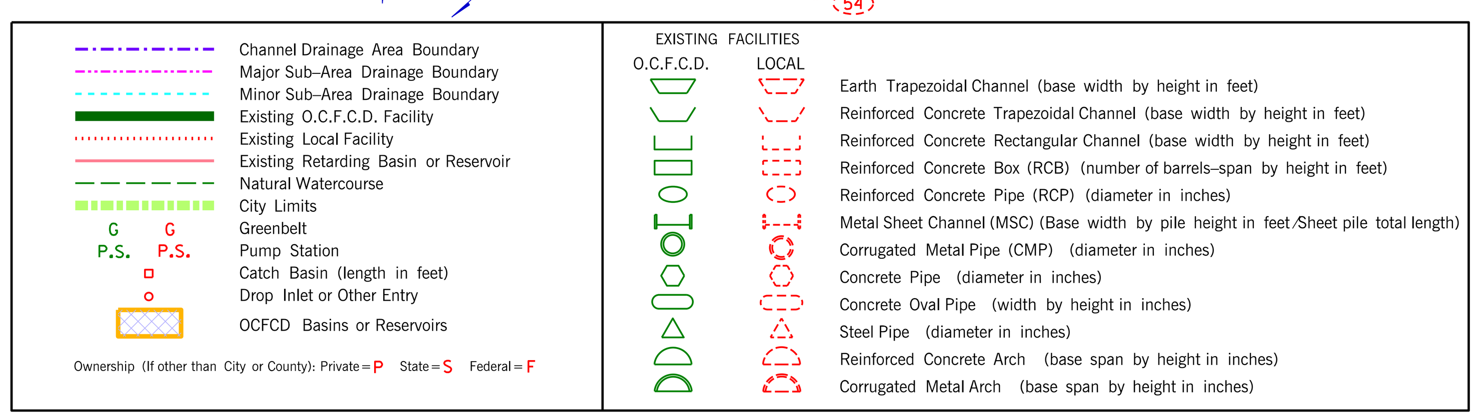
Additional information may be obtained from public plans and recorded deeds. Facility designations included with this information are for convenience only and are not controlling or intended to imply ownership by the County or the Orange County Flood Control District (OCFCD). The information is being provided as a courtesy and neither the County of Orange nor OCFCD assume any liabilities for inaccuracy of the information.

To notify OC Public Works Flood Control Section of additions or corrections, please contact Sal Gutierrez at (714) 834–5396 or by email at sal.gutierrez@ocpw.ocgov.com

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	MAR 12/2007	50	MAPS–113–3



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MEMORANDUM

GLENN LUKOS ASSOCIATES

Regulatory Services

PROJECT NUMBER: 12960001CANA

TO: Steve Guzowski

FROM: Tony Bomkamp

DATE: August 15, 2017

SUBJECT: Jurisdictional Limits for California Department of Fish and Wildlife and U.S. Army Corps of Engineers for Serrano Creek Southern/Eastern Bank

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On June 21 and July 10, 2017, GLA conducted site visits to identify the limits of Corps and CDFW jurisdictional boundaries for the edge of Serrano Creek within the Project site, which depending on the specific segment of Serrano Creek represents the southern or eastern bank of the stream. GLA also evaluated the site to determine whether any sensitive species and/or communities are likely to occur onsite. [Exhibit 1 – Regional Map, Exhibit 2 – Vicinity Map]. Exhibits 3, 3a, and 3b depict the limits of Corps and CDFW jurisdiction.

I. METHODOLOGY

Prior to beginning the field delineation, GLA conducted a reconnaissance visit on June 21, 2017 to review the site and determine the most appropriate methodology for mapping the limits of jurisdiction. During the reconnaissance visit, it became apparent that CDFW jurisdiction exceeded Corps jurisdiction and thus, it was determined that mapping of CDFW jurisdiction would be prioritized for purposes of site planning and avoidance to eliminate the need for Section 1602 and Section 404 Authorizations. Specifically, Section 404 jurisdiction is defined by the presence of an Ordinary High Water Mark (OHWM), which is typically located on the lower terraces of streams; whereas CDFW typically takes jurisdiction to the top of bank or outer limit of riparian habitat (whichever is greater). As such, CDFW always exceeds Corps jurisdiction with the only exception being the presence of adjacent wetlands, which do not occur in areas adjacent to Serrano Creek. During the July 10 site visit, GLA mapped the extent of CDFW jurisdiction using either the top of bank or riparian habitat that extends beyond the top of bank (e.g., native trees such as willow and non-native vegetation such as giant reed). Corps jurisdiction was also mapped for the areas between the western project limits and Dimension Drive. As noted, and depicted on Exhibits 3, 3a and 3c, CDFW jurisdiction exceeds Corps jurisdiction in all areas of Serrano Creek. As discussed below, the delineation effort began at the western limits of the site and worked upstream. Descriptions for specific segments of Serrano between the downstream limits and Dimension Drive follow the nomenclature provided on Exhibit 4.

The Soil Conservation Service (SCS)[1] has mapped the following soil types as occurring in the general vicinity of the project site:

Cieneba Sandy Loam, 15 to 30 Percent Slopes

The Cieneba series consists of somewhat excessively drained soils. These soils formed in material weathered from granitic rocks of the Santa Ana Mountains and from the sandstone of the coastal foothills. Slopes are 9 to 75 percent. Typically, the surface layer is light brownish gray and pale brown sandy loam 7 inches thick. The underlying material is weathered granodiorite.

Myford Sandy Loam, 15 to 30 Percent Slopes

The Myford series consists of moderately well drained soils on marine terraces. These soils formed in sandy sediments. Slopes are 0 to 30 percent. In a typical profile, the surface layer is pale brown and pinkish gray, medium acid sandy loam 4 inches thick. The upper 6 inches of the subsoil is brown, medium acid sandy clay; the next 17 inches is brown, neutral, and moderately alkaline sandy clay loam; and the lower 36 inches is light brown, calcerous sandy clay loam and sandy loam. The substratum is very pale brown slightly acid sandy loam to a depth of 79 inches or more.

Riverwash

Riverwash consists of areas of unconsolidated alluvium, generally stratified and varying widely in texture, recently deposited by intermittent streams, and subject to frequent changes through stream overflow. These are sandy, gravelly, cobbly, and boulder deposits that support little or no vegetation. Runoff is generally rapid, and the erosion hazard is high. Deposition and removal of fresh alluvium are common.

Sorrento Loam, 2 to 9 Percent Slopes

The Sorrento series consists of well drained soils on alluvial fans and flood plains. These soils formed in alluvium derived from sedimentary rocks. Slopes are 0 to 9 percent. In a typical profile, the surface layer is grayish brown loam, 12 inches thick. The underlying material is grayish brown, light brownish gray, and pale brown silty clay loam to a depth of 62 inches and light brownish gray sandy loam to a depth of 72 inches or more.

[1] SCS is now known as the National Resource Conservation Service or NRCS.

None of these soil units are identified as hydric in the SCS's publication, Hydric Soils of the United States[2].

II. EXISTING CONDITIONS

A. Area Below the Bridge at Dimension Drive

As depicted on Exhibit 4, the area downstream of Dimension is composed of five segments associated with the Areas I – V on Exhibit 4. Starting at the upstream limits the sequence on Exhibit 4 is as follows: Area IV, Area III, Area II, Area V and Area I.

Area IV

Area IV consists of disturbed ground and is occupied by an equestrian riding ring. The edge of Serrano Creek adjacent to Area IV is highly disturbed and is predominantly vegetated with non-native species including Brazilian pepper (*Schinus terebinthifolius*), castor bean (*Ricinus communis*), blue-gum eucalyptus (*Eucalyptus globulus*), English ivy (*Hedera helix*), giant reed (*Arundo donax*), Mexican fan palm (*Washintonia robusta*), pampas grass (*Cortedaria selloana*), black mustard (*Brassica nigra*), summer mustard (*Hirschfeldia incana*), tree tobacco (*Nicotiana glauca*), and white horehound (*Marrubiam vulgare*), as well as a small amount of native species including black willow (*Salix gooddingii*), coast live oak (*Quercus agrifolia*), and poison oak (*Toxicodendron diversilobum*).

Area III

Area III is entirely disturbed, occupied largely by stables and sheds and disturbed ground. The edge of Serrano Creek in Area III is highly disturbed and is predominantly vegetated with the non-native species observed in Area IV including Brazilian pepper tree, castor bean, blue-gum eucalyptus, English ivy, giant reed, Mexican fan palm, pampas grass, summer mustard, tree tobacco, and white horehound, as well as a small amount of native species including black willow, coast live oak and poison oak.

Area II

Area II consists of disturbed ground and is occupied by nursery plants. The end of Serrano Creek in Area II is highly disturbed and is predominantly vegetated with non-native species

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[2] United States Department of Agriculture, Soil Conservation Service. 1991. Hydric Soils of the United States, 3rd Edition, Miscellaneous Publication Number 1491. (In cooperation with the National Technical Committee for Hydric Soils.)

including Brazilian pepper tree, castor bean, blue-gum eucalyptus, English ivy, giant reed, Mexican fan palm, pampas grass, summer mustard, tree tobacco, and white horehound, as well as a small amount of native species including black willow, coast live oak, and poison oak.

Area V

Area V is entirely disturbed, consisting of several larch mulch piles and a stand of eucalyptus. The edge of Serrano Creek in Area V is highly disturbed and is predominantly vegetated with non-native species including Brazilian pepper tree, castor bean, blue-gum eucalyptus, English ivy, giant reed, Mexican fan palm, pampas grass, summer mustard, tree tobacco, and white horehound, as well as a small amount of native species including black willow, coast live oak, and poison oak.

Area I

Area I is vegetated with a predominance of coast live oak trees as well as non-natives species including aloe (*Aloe arborescens*), castor bean, eucalyptus, giant reed, Mexican fan palm, pampas grass, smilo grass (*Stipa miliacea*), and tree tobacco, and native plants including black willow, mugwort (*Artemisia douglasiana*), mulefat (*Baccharis salicifolia*), and bluewitch nightshade (*Solanum umbelliferum*).

B. <u>Area Upstream of Dimension Drive</u>

The area above the Dimension Drive Bridge is vegetated with a predominance of coast live oak with occasional blue elderberry (*Sambucus nigra* ssp. *caerulea*) and California sycamore (*Platanus racemose*). Understory species form a mosaic with non-native species including aloe, bigleaf periwinkle (*Vinca major*), castor bean, eucalyptus, Italian thistle (*Carduus pycnocephalus*), pampas grass, smilo grass, summer mustard, tree of heaven (*Ailanthus altissima*), and tree tobacco, and native species including California sage brush (*Artemisia californica*), jimson weed (*Datura stramonium*), horseweed (*Erigeron canadensis*), mugwort, mulefat, and poison oak. The Serrano Creek Bike and Equestrian Trail parallels Serrano Creek for this entire segment of Serrano Creek, and is set back only a few feet from the southern edge of Serrano Creek and associated coast live oak riparian habitat.

IV. RESULTS

B. <u>CDFW Jurisdiction</u>

The limits of CDFW jurisdiction are depicted on Exhibit 4 and extends to the top of the Serrano Creek bank, or to edge of the canopy of associated riparian vegetation that is rooted at the top of bank or below top of bank. The riparian habitat typically consists of native trees such as willows and western sycamores but also includes on patch of giant reed.

A. <u>Corps Jurisdiction</u>

The limits of Corps jurisdiction are determined by the Ordinary High Water Mark (OHWM) which in all areas of Serrano Creek evaluated is below the top of bank as depicted on Exhibit 4. As such, avoidance of CDFW jurisdiction would ensure that all areas of Corps jurisdiction are also fully avoided.

IV. DISCUSSION OF RESTORATION OPPORTUNITIES

A. <u>Restoration Opportunities Downstream of Dimension Drive</u>

The segment of Serrano Creek between the downstream limits and Dimension Drive exhibit restoration opportunities due to the high percentage of non-native invasive species such as giant reed, pampas grass, English ivy, castor bean, Brazilian pepper, blue-gum eucalyptus, and other non-native species. Also, the banks of the channel have been fortified by additions of concrete rubble. Because of the highly-urbanized setting of this segment of Serrano Creek, it is not a good candidate for restoration, strictly for purposes of selling mitigation credits due to the low value that the resource agencies would assign for such credits. In addition, restoration would require authorizations from the CDFW for modifications to the streambank (even if it was determined to have beneficial effects). It would also require a Nationwide Permit 27 from the Corps, which covers stream restoration.

B. <u>Restoration Opportunities Upstream of Dimension Drive</u>

The segment of Serrano Creek between the Dimension Drive and the upstream limits exhibit fewer restoration opportunities than the downstream segment due to the generally high cover of coast live oaks. The stream channel is less disturbed than the upstream segment; however, it is also much drier and the banks support a predominance of upland vegetation making establishment of riparian species essentially impossible. Similarly, because of the highly-urbanized setting of this segment of Serrano Creek, like the downstream segment, it not a good candidate for restoration with the intent of selling mitigation credits due to the low value that the resource agencies would assign for such credits. As already noted, restoration would require authorizations from the CDFW for modifications to the streambank (even if it was determined to have beneficial effects). It would also require a Nationwide Permit 27 from the Corps, which covers stream restoration.

V. SPECIAL STATUS SPECIES

During the site visits, GLA conducted a habitat assessment for special status plants and animals as addressed below.

A. Special-Status Plants

Areas I – V were evaluated for the presence of special-status plants and/or habitat for special-status plants. Because of the high level of disturbance exhibited by these areas, they do not support habitat for special-status plants and as such exhibit no potential for the presence of special-status plants. Similarly, Serrano Creek within the Study Area does not contain suitable habitat for special-status plants. As such, there is no potential for impacts to special-status plants associated with the project.

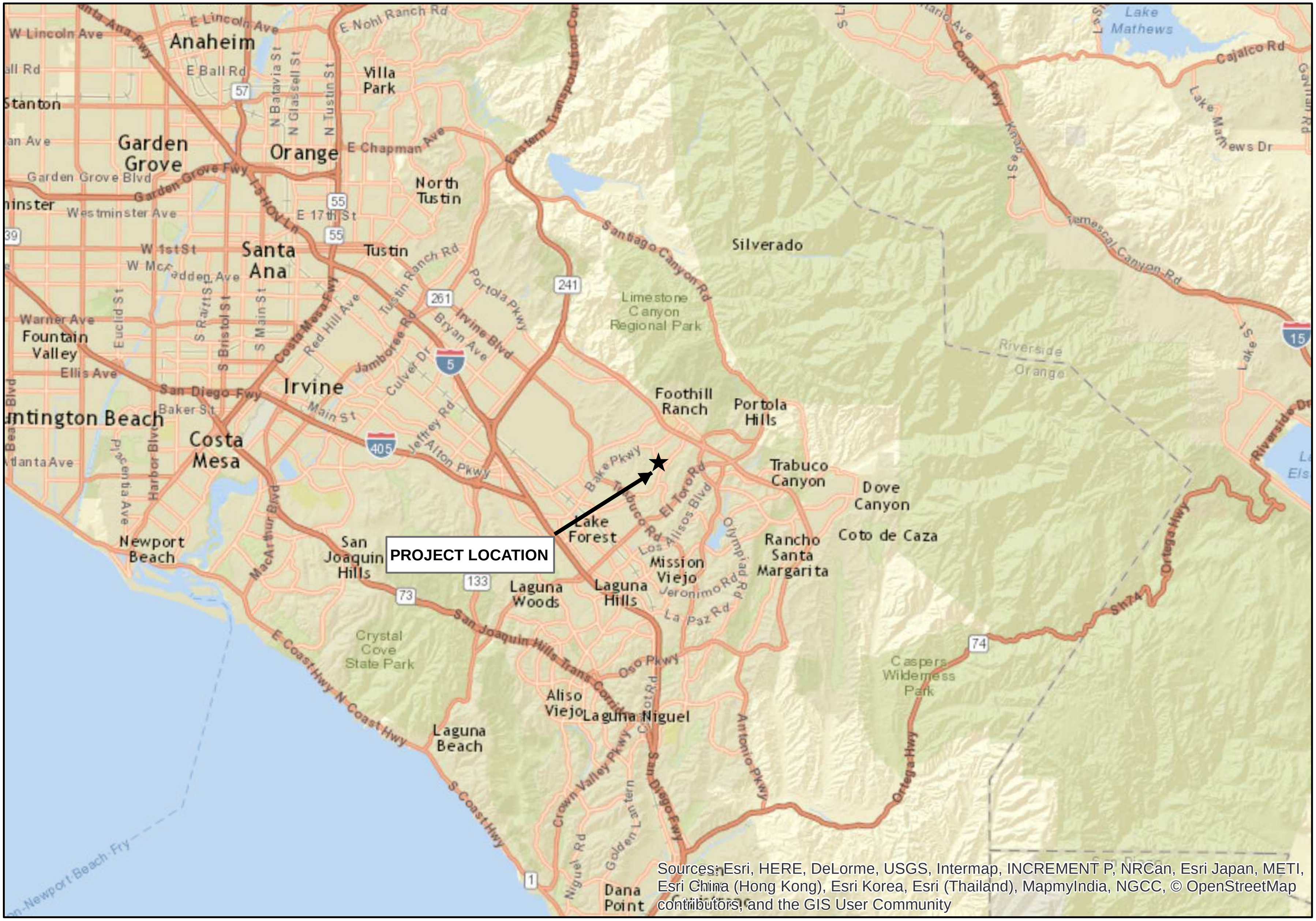
B. Special -Status Animals

Areas I – V were evaluated for the presence of special-status animals and/or habitat for special-status animals. Because of the high level of disturbance exhibited by these areas, they do not support habitat for special-status animals and as such exhibit no potential for the presence of special-status animals. Serrano Creek within the Study Area does not contain suitable habitat for special-status avifauna with the exception of yellow warbler, a California species of special concern. Yellow warbler was not detected during the site visits; however, even if it would occur, the project would not impact any potential habitat.

Portions of Serrano Creek downstream, of Dimension Drive exhibit flowing and/or standing water and could support the western pond turtle, a California species of special concern. Western pond turtles were not detected during the site visits; however, the site visits did not include focused surveys for this species. Nevertheless, the project would fully avoid impacts to Serrano Creek including areas of potential habitat for the western pond turtle and the project has no potential for impacts to this species.

There are no other special-status species with potential to occur within Areas I – V or that could occupy Serrano Creek that could be impacted by the project.

Source: ESRI World Street Map



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0 2 4 8
Miles

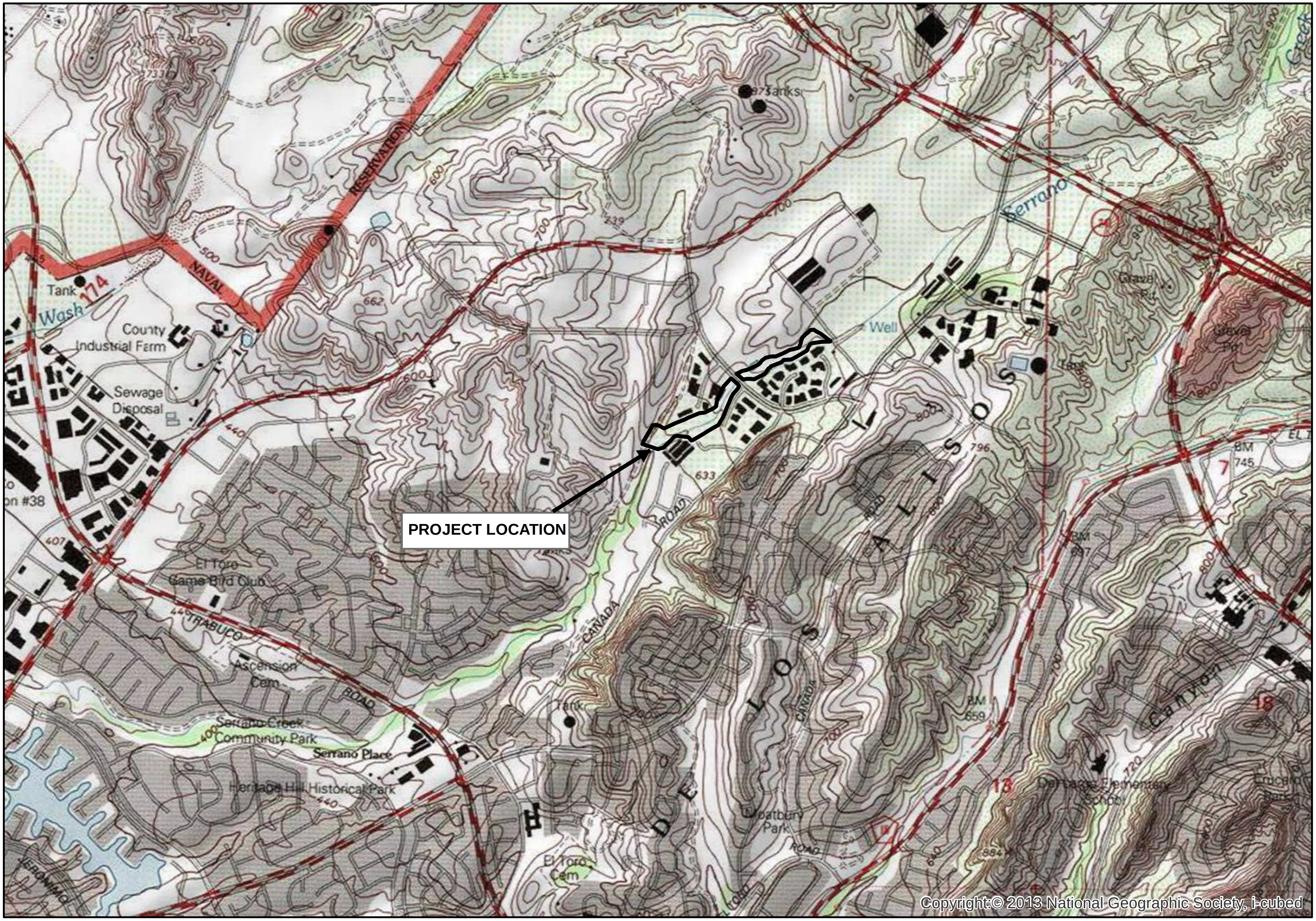
SERRANO CREEK

Regional Map

GLENN LUKOS ASSOCIATES

Exhibit 1

Adapted from USGS El Toro, CA quadrangle



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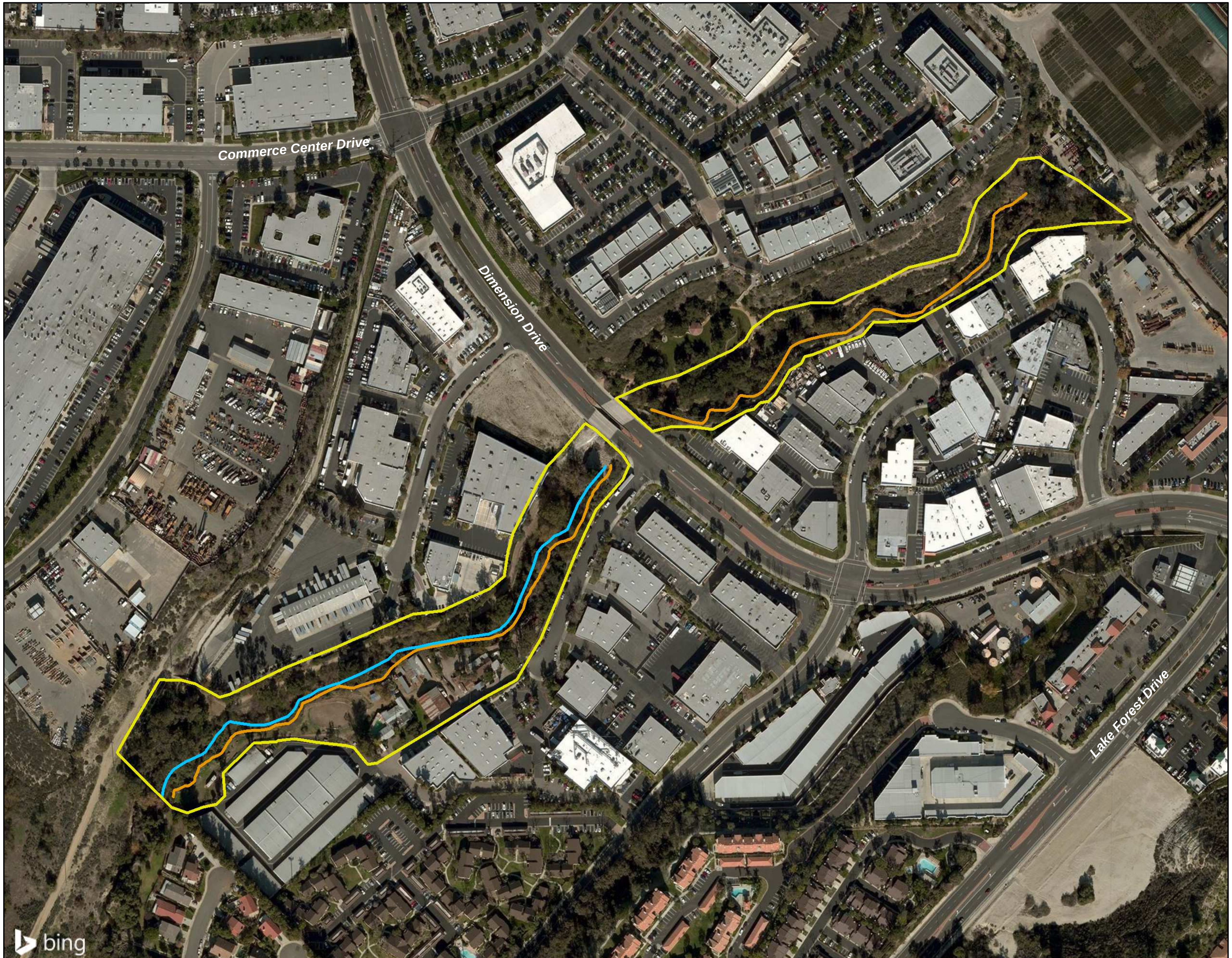
0
1,000
2,000
4,000
Feet

SERRANO CREEK

Vicinity Map

GLENN LUKOS ASSOCIATES

Exhibit 2



Approximate Study Area
Limits of Corps Jurisdiction
Limits of CDFW Jurisdiction

N

0 100 200 400
Feet

1 inch = 250 feet

Coordinate System: State Plane 6 NAD 83
Projection: Lambert Conformal Conic
Datum: NAD83
Map Prepared by: C. Lukos, GLA
Date Prepared: August 4, 2017

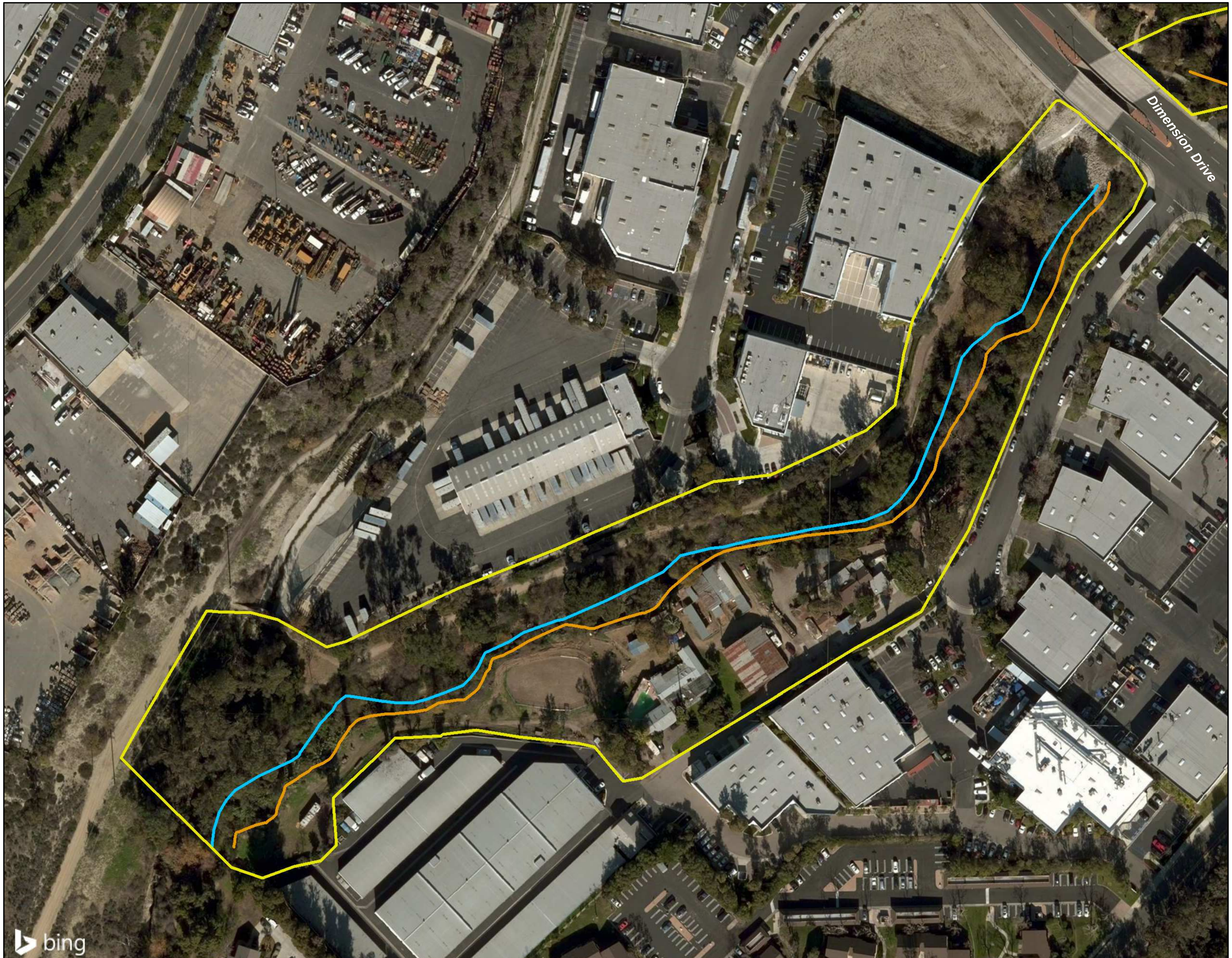
SERRANO CREEK

Limits of Jurisdiction Map

GLENN LUKOS ASSOCIATES

Exhibit 3 Key Map

X:\1100 AFTER THE REST\1296-01CANA\1296-1GIS\1296-1AerialEX3.mxd



Approximate Study Area
Limits of Corps Jurisdiction
Limits of CDFW Jurisdiction

N

0 62.5 125 250
Feet

1 inch = 125 feet

Coordinate System: State Plane 6 NAD 83
Projection: Lambert Conformal Conic
Datum: NAD83
Map Prepared by: C. Lukos, GLA
Date Prepared: August 4, 2017

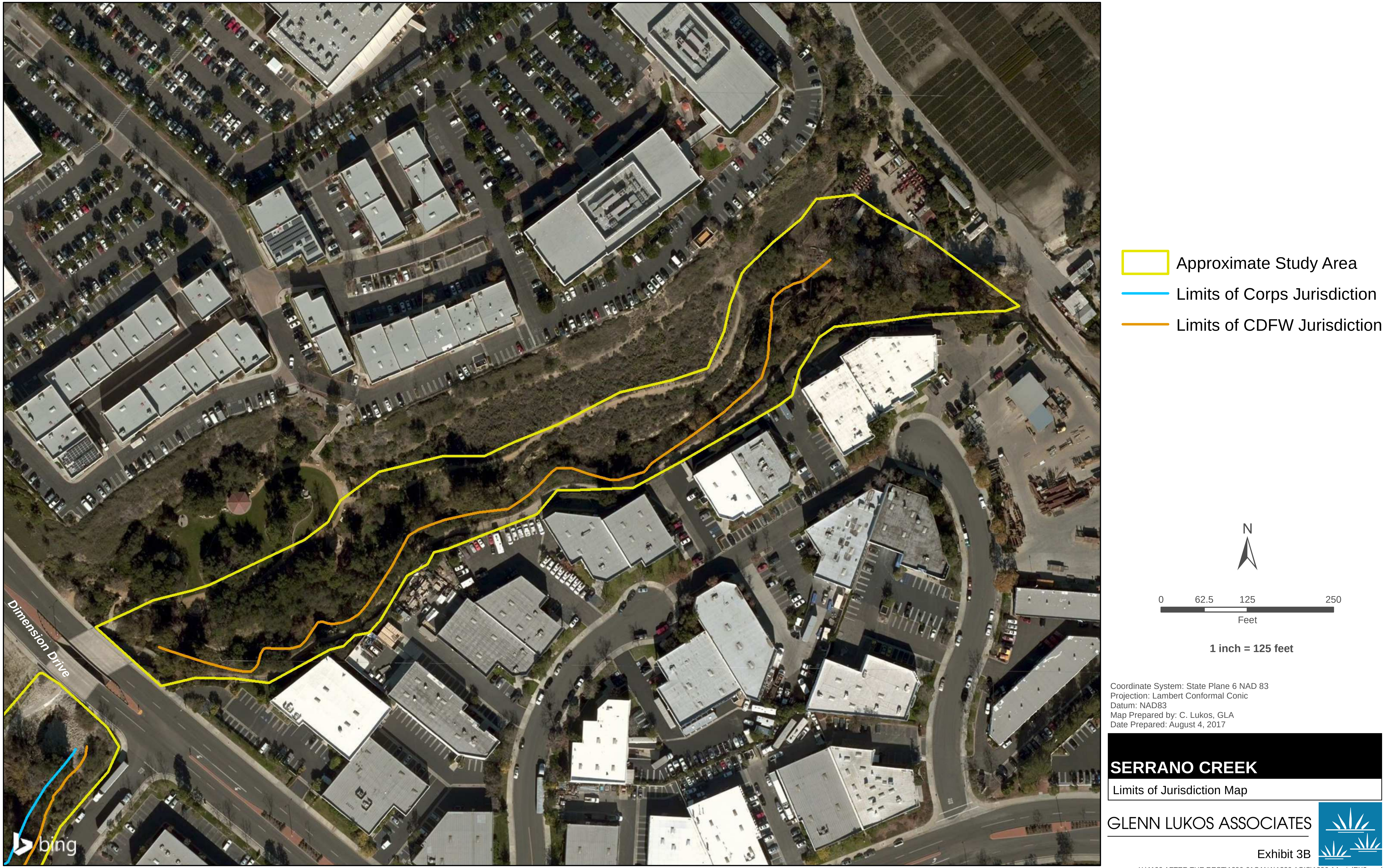
SERRANO CREEK

Limits of Jurisdiction Map

GLENN LUKOS ASSOCIATES

Exhibit 3A

X:\1100 AFTER THE REST\1296-01CANA\1296-1GIS\1296-1AerialEX3.mxd



Coordinate System: State Plane 6 NAD 83
Projection: Lambert Conformal Conic
Datum: NAD83
Map Prepared by: C. Lukos, GLA
Date Prepared: August 4, 2017

SERRANO CREEK

Limits of Jurisdiction Map

GLENN LUKOS ASSOCIATES

Exhibit 3B

X:\1100 AFTER THE REST\1296-01CANA\1296-1GIS\1296-1AerialEX3.mxd

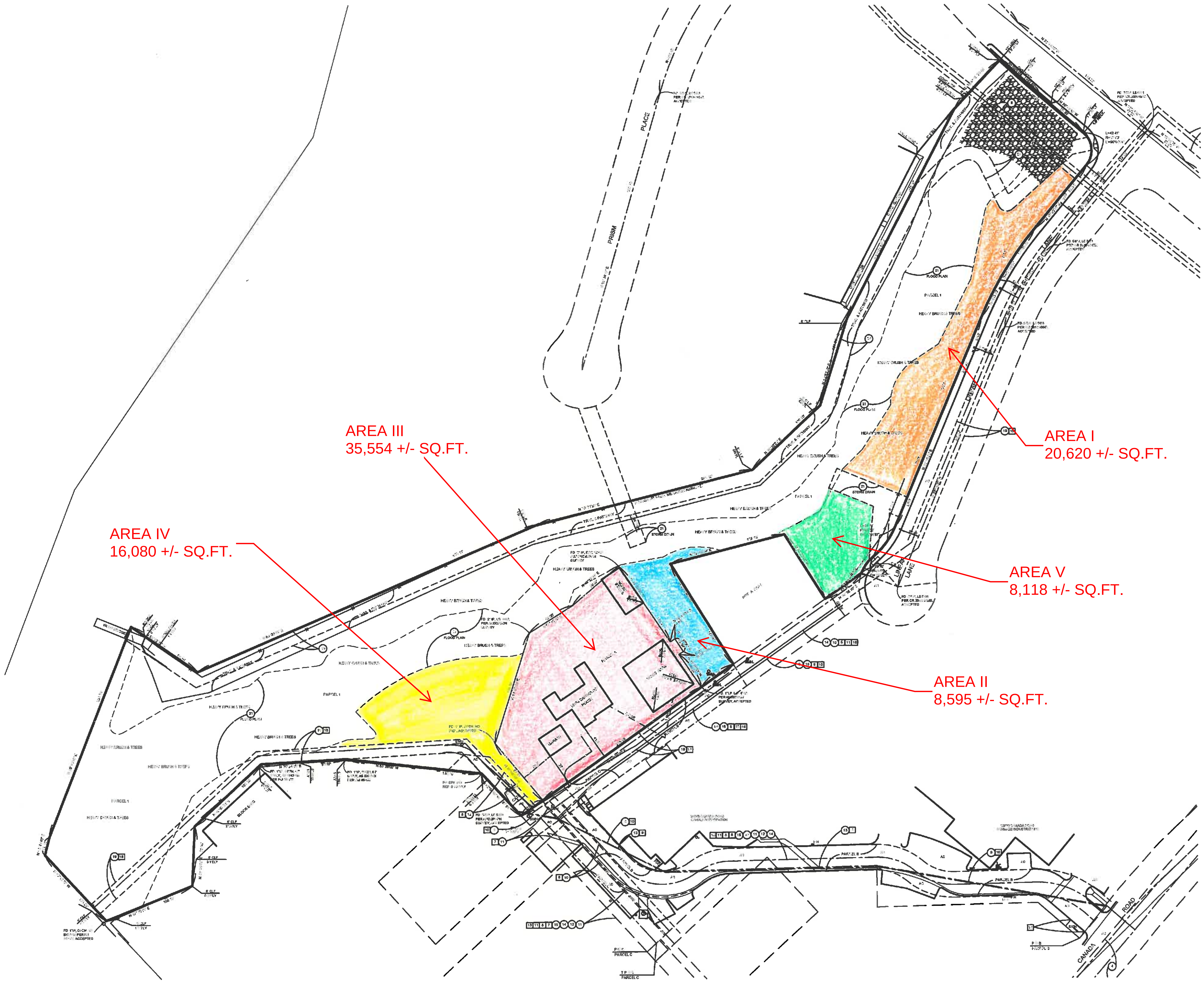
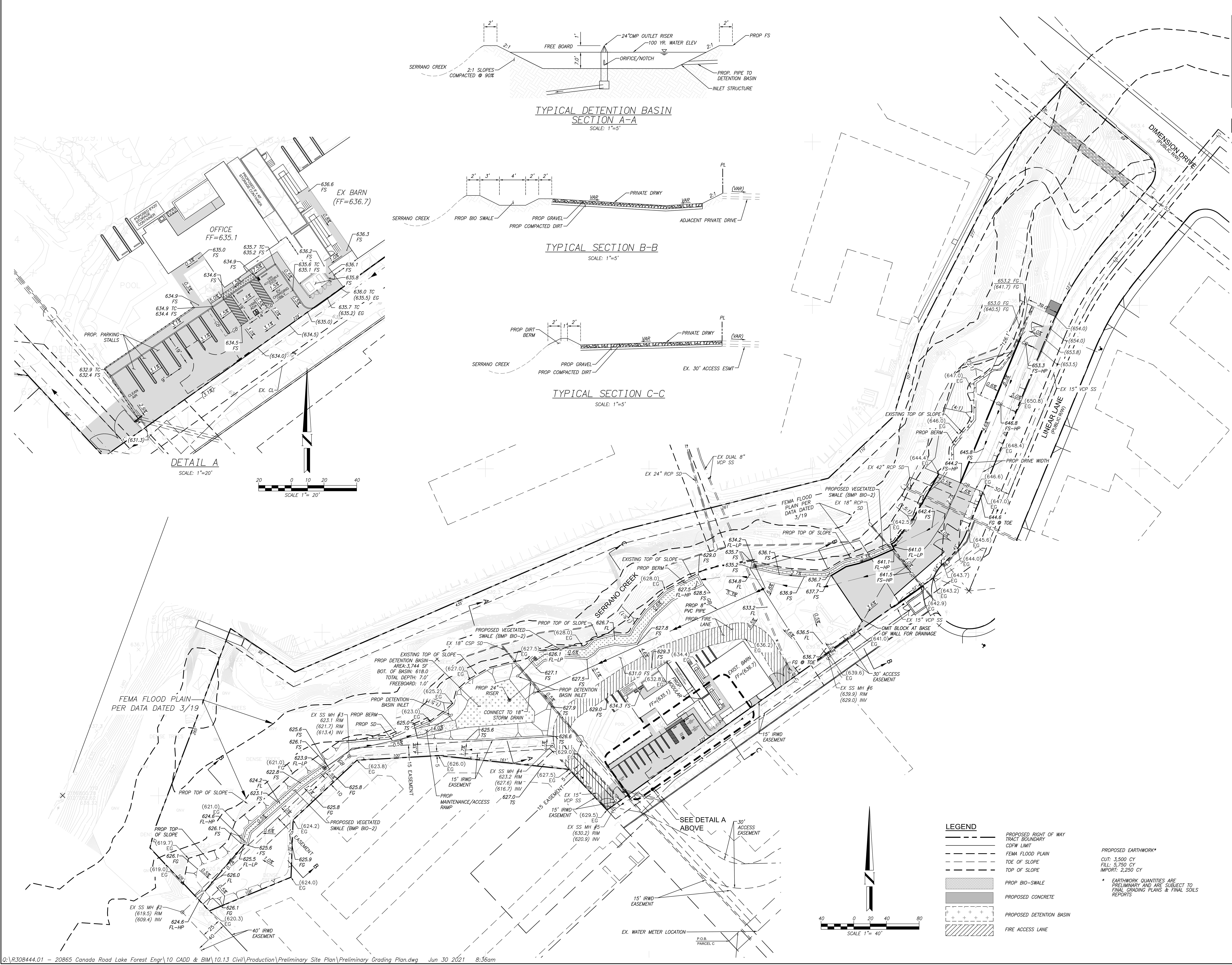

AREA I
20,620 +/- SQ.FT.
AREA II
8,595 +/- SQ.FT.
AREA III
35,554 +/- SQ.FT.
AREA IV
16,080 +/- SQ.FT.
AREA V
8,118 +/- SQ.FT.
PRISM
PLACE

Exhibit 4

APPENDIX B

Exhibits



HERDMAN
ARCHITECTURE + DESIGN

16201 SCIENTIFIC WAY
IRVINE, CA 92618
TEL. 14.389.2800
www.Herdman-AD.com

PROJECT

GREAT SCOTT
TREE SERVICE

2065 CANADA ROAD
LAKE FOREST, CA

CLIENT

GREAT SCOTT
TREE SERVICE INC.

10 61 COURT AVENUE
STANTON, CA 90680

PROJECT TEAM
GENERAL CONTRACTOR
T.B.D.

CIVIL
HUITT - ZOLLARS INC.

PROJECT MANAGEMENT
E P D SOLUTIONS INC.

DRAWING INFO

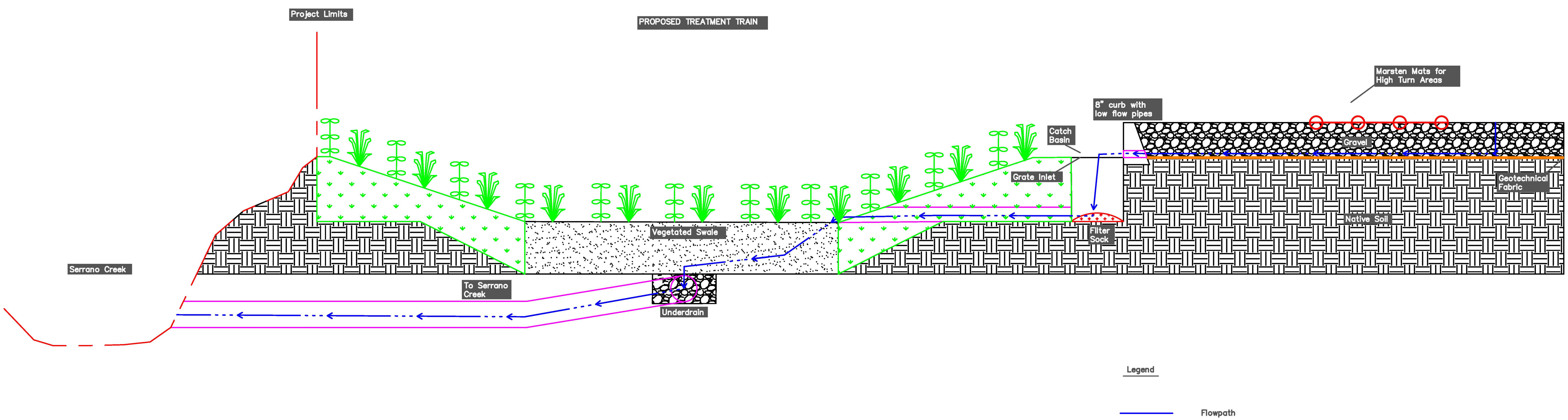
ID	DATE	DESCRIPTION
		PLAN CHECK No. 000

DRAWN: S
H-A&D JOB: A19-2049
ISSUE: -
DRAWING SCALE: AS SHOWN

PRELIMINARY GRADING AND DRAINAGE PLAN GREAT SCOTT PROPERTY

C1.0

06/30/21



Project Limits
PROPOSED TREATMENT TRAIN
Marsten Mats for High Turn Areas
8" curb with low flow pipes
Catch Basin
Gravel
Grate Inlet
Geotechnical Fabric
Native Soil
Vegetated Swale
Filter Sock
Serrano Creek
To Serrano Creek
Underdrain
Legend
Flowpath

PREPARED BY:

HUITT-ZOLLARS

Huitt-Zollars, Inc. Irvine
2603 Main Street, Suite 400
Irvine, California 92614
Phone (949) 988-5815 Fax (949) 988-5820

Marc Haslinger, P.E. DATE

R.C.E. No.

REGISTERED PROFESSIONAL ENGINEER
MARC J. HASLINGER
No. 49158
Expiration 09-30-20
CIVIL
STATE OF CALIFORNIA

REVISIONS

MARK	DATE	DESCRIPTION	BY

REVIEWED BY:

DATE

DATE

20865 Canada Road Lake Forest
EXISTING HYDROLOGY MAP

SCALE: **AS NOTED**

SHEET No. 1 OF 1

DRAWING NUMBER

DRAWN BY: HZ

CHECKED BY: MH

Q:\R308444.01 – 20865 Canada Road Lake Forest Engr\10 CADD & BIM\10.13 Civil\Hydro\Existing Drainage Exhibit.dwg

PREPARED BY:

HUITT-ZOLLARS

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CIVIL
STATE OF CALIFORNIA

REVISIONS

MARK	DATE	DESCRIPTION	BY

REVIEWED BY:
DATE
DATE

20865 Canada Road Lake Forest
PROPOSED HYDROLOGY MAP

SCALE: AS NOTED
DRAWN BY: HZ
CHECKED BY: MH
SHEET No. 1 OF 1
DRAWING NUMBER

APPENDIX C

Calculations

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2014 Advanced Engineering Software (aes)
             Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                           Analysis prepared by:

                             Huitt-Zollars, Inc.
                     2603 Main Street, Irvine CA. 92614
                                Suite 400
                               949-988-5815


 ************************** DESCRIPTION OF STUDY **************************
* Great Scott - Lake Forest Existing Hydrology                              *
* Rational Method 100-year storm event                                      *
* Ryan Kim 2/11/2020 Revised by ATS 10/07/2020, VAA 06/15/2021              *
 **************************************************************************

  FILE NAME: GS100E.DAT
  TIME/DATE OF STUDY: 15:37 06/15/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *PIPE MAY BE SIZED TO HAVE A FLOW CAPACITY LESS THAN
   UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   164.30
  ELEVATION DATA: UPSTREAM(FEET) =    650.00  DOWNSTREAM(FEET) =    631.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.364
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.607
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "OPEN BRUSH"               D        0.32      0.20     1.000    96    8.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      1.25
  TOTAL AREA(ACRES) =      0.32   PEAK FLOW RATE(CFS) =      1.25

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    105.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    631.00  DOWNSTREAM(FEET) =    629.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.60   CHANNEL SLOPE =  0.0360
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.25
  FLOW VELOCITY(FEET/SEC) =   2.97 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.31   Tc(MIN.) =    8.68
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    105.00 =     219.90 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   248.60
  ELEVATION DATA: UPSTREAM(FEET) =    645.00  DOWNSTREAM(FEET) =    638.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
```

```
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.215
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.015
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.41      0.20     0.500    91    7.21
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA RUNOFF(CFS) =      1.82
  TOTAL AREA(ACRES) =      0.41   PEAK FLOW RATE(CFS) =      1.82

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    638.00  DOWNSTREAM(FEET) =    630.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   226.50   CHANNEL SLOPE =  0.0353
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.82
  FLOW VELOCITY(FEET/SEC) =   3.17 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.19   Tc(MIN.) =    8.40
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     475.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.40
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.595
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.37      0.20     0.500    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA AREA(ACRES) =    0.37      SUBAREA RUNOFF(CFS) =    1.49
  EFFECTIVE AREA(ACRES) =      0.78   AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.50
  TOTAL AREA(ACRES) =        0.8       PEAK FLOW RATE(CFS) =       3.16

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    503.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =    630.00  DOWNSTREAM(FEET) =    610.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   285.20   CHANNEL SLOPE =  0.0701
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.16
  FLOW VELOCITY(FEET/SEC) =   5.03 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.95   Tc(MIN.) =    9.35
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.35
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.323
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "1 DWELLING/ACRE"          D        0.23      0.20     0.800    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.88
  EFFECTIVE AREA(ACRES) =      1.02   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.57
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =       3.85

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.85    9.35    4.323  0.20( 0.11) 0.57       1.0     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.25    8.68    4.512  0.20( 0.20) 1.00       0.3     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    503.00 =     219.90 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.99    8.68    4.512  0.20( 0.14) 0.68       1.3     400.00
      2        5.05    9.35    4.323  0.20( 0.13) 0.67       1.3     500.00
    TOTAL AREA(ACRES) =        1.3
```

```
  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        5.05  Tc(MIN.) =    9.350
  EFFECTIVE AREA(ACRES) =      1.33  AREA-AVERAGED Fm(INCH/HR) =  0.13
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.68
  TOTAL AREA(ACRES) =        1.3
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    603.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    610.00  DOWNSTREAM(FEET) =    608.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    76.20   CHANNEL SLOPE =  0.0262
  CHANNEL FLOW THRU SUBAREA(CFS) =       5.05
  FLOW VELOCITY(FEET/SEC) =   3.43 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.37   Tc(MIN.) =    9.72
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   297.60
  ELEVATION DATA: UPSTREAM(FEET) =    643.00  DOWNSTREAM(FEET) =    635.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.242
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.004
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS               D        0.50      0.20     0.350    91    7.24
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      2.23
  TOTAL AREA(ACRES) =      0.50   PEAK FLOW RATE(CFS) =      2.23

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    635.00  DOWNSTREAM(FEET) =    630.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   225.00   CHANNEL SLOPE =  0.0222
  CHANNEL FLOW THRU SUBAREA(CFS) =       2.23
  FLOW VELOCITY(FEET/SEC) =   2.62 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.43   Tc(MIN.) =    8.67
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    602.00 =     522.60 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    602.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.67
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.513
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.50      0.20     0.500    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA AREA(ACRES) =    0.50      SUBAREA RUNOFF(CFS) =    1.99
  EFFECTIVE AREA(ACRES) =      1.00   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.42
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =       4.00

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    603.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    630.00  DOWNSTREAM(FEET) =    608.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   279.50   CHANNEL SLOPE =  0.0787
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.00
  FLOW VELOCITY(FEET/SEC) =   5.62 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =    9.50
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    603.00 =     802.10 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.283
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        0.47      0.20     0.900    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    1.72
  EFFECTIVE AREA(ACRES) =      1.47   AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.58
  TOTAL AREA(ACRES) =        1.5       PEAK FLOW RATE(CFS) =       5.51

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.51    9.50    4.283  0.20( 0.12) 0.58       1.5     600.00
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    603.00 =     802.10 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.99    9.05    4.405  0.20( 0.14) 0.68       1.3     400.00
      2        5.05    9.72    4.227  0.20( 0.13) 0.67       1.3     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       10.39    9.05    4.405  0.20( 0.12) 0.62       2.7     400.00
      2       10.54    9.50    4.283  0.20( 0.12) 0.62       2.8     600.00
      3       10.48    9.72    4.227  0.20( 0.12) 0.62       2.8     500.00
    TOTAL AREA(ACRES) =         2.8

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       10.54  Tc(MIN.) =    9.500
  EFFECTIVE AREA(ACRES) =      2.78  AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.62
  TOTAL AREA(ACRES) =        2.8
```

```
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    704.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    608.00  DOWNSTREAM(FEET) =    600.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   260.10   CHANNEL SLOPE =  0.0308
  CHANNEL FLOW THRU SUBAREA(CFS) =      10.54
  FLOW VELOCITY(FEET/SEC) =   4.44 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.98   Tc(MIN.) =   10.48
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    704.00 =    1096.60 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    704.00 TO NODE    704.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.48
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.050
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        0.29      0.20     0.900    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA AREA(ACRES) =    0.29      SUBAREA RUNOFF(CFS) =    1.02
  EFFECTIVE AREA(ACRES) =      3.07   AREA-AVERAGED Fm(INCH/HR) =  0.13
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.65
  TOTAL AREA(ACRES) =        3.1       PEAK FLOW RATE(CFS) =      10.83
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.1  TC(MIN.) =     10.48
  EFFECTIVE AREA(ACRES) =      3.07  AREA-AVERAGED Fm(INCH/HR)=  0.13
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.648
  PEAK FLOW RATE(CFS)   =      10.83

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       10.68   10.03    4.153  0.20( 0.13) 0.65       3.0     400.00
```

```
      2       10.83   10.48    4.050  0.20( 0.13) 0.65       3.1     600.00
      3       10.78   10.70    4.002  0.20( 0.13) 0.65       3.1     500.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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              Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                            Analysis prepared by:

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                                 Suite 400
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 ************************** DESCRIPTION OF STUDY **************************
 * Great Scott - Lake Forest Existing Hydrology                             *
 * Rational Method 25-year storm event                                      *
 * Ryan Kim 2/11/2020 Revised by ATS 10/07/2020, VAA 06/15/2021             *
 **************************************************************************

  FILE NAME: GS25E.DAT
  TIME/DATE OF STUDY: 15:41 06/15/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *PIPE MAY BE SIZED TO HAVE A FLOW CAPACITY LESS THAN
   UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   164.30
  ELEVATION DATA: UPSTREAM(FEET) =    650.00  DOWNSTREAM(FEET) =    631.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.364
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.605
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "OPEN BRUSH"               D        0.32      0.20     1.000    83    8.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.97
  TOTAL AREA(ACRES) =      0.32   PEAK FLOW RATE(CFS) =      0.97

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    105.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    631.00  DOWNSTREAM(FEET) =    629.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.60   CHANNEL SLOPE =  0.0360
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.97
  FLOW VELOCITY(FEET/SEC) =   2.84 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.33   Tc(MIN.) =    8.69
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    105.00 =     219.90 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   248.60
  ELEVATION DATA: UPSTREAM(FEET) =    645.00  DOWNSTREAM(FEET) =    638.00
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.215
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.920
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.41      0.20     0.500    75    7.21
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA RUNOFF(CFS) =      1.42
  TOTAL AREA(ACRES) =      0.41   PEAK FLOW RATE(CFS) =      1.42

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    638.00  DOWNSTREAM(FEET) =    630.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   226.50   CHANNEL SLOPE =  0.0353
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.42
  FLOW VELOCITY(FEET/SEC) =   3.02 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.25   Tc(MIN.) =    8.47
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     475.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.47
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.580
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.37      0.20     0.500    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA AREA(ACRES) =    0.37      SUBAREA RUNOFF(CFS) =    1.16
  EFFECTIVE AREA(ACRES) =      0.78   AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.50
  TOTAL AREA(ACRES) =       0.8       PEAK FLOW RATE(CFS) =       2.45

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    503.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
```

```
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    630.00  DOWNSTREAM(FEET) =    610.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   285.20   CHANNEL SLOPE =  0.0701
  CHANNEL FLOW THRU SUBAREA(CFS) =       2.45
  FLOW VELOCITY(FEET/SEC) =   4.76 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.00   Tc(MIN.) =    9.47
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.47
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.361
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "1 DWELLING/ACRE"          D        0.23      0.20     0.800    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.68
  EFFECTIVE AREA(ACRES) =      1.02   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.57
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =      2.97

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.97    9.47    3.361  0.20( 0.11) 0.57       1.0     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.97    8.69    3.528  0.20( 0.20) 1.00       0.3     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    503.00 =     219.90 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.83    8.69    3.528  0.20( 0.14) 0.68       1.2     400.00
      2        3.89    9.47    3.361  0.20( 0.13) 0.67       1.3     500.00
```

```
   TOTAL AREA(ACRES) =         1.3

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        3.89  Tc(MIN.) =    9.466
  EFFECTIVE AREA(ACRES) =      1.33  AREA-AVERAGED Fm(INCH/HR) =  0.13
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.68
  TOTAL AREA(ACRES) =       1.3
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    603.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    610.00  DOWNSTREAM(FEET) =    608.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    76.20   CHANNEL SLOPE =  0.0262
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.89
  FLOW VELOCITY(FEET/SEC) =   3.22 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.39   Tc(MIN.) =    9.86
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   297.60
  ELEVATION DATA: UPSTREAM(FEET) =    643.00  DOWNSTREAM(FEET) =    635.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.242
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.911
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS               D        0.50      0.20     0.350    75    7.24
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      1.74
  TOTAL AREA(ACRES) =      0.50   PEAK FLOW RATE(CFS) =      1.74

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    635.00  DOWNSTREAM(FEET) =    630.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   225.00   CHANNEL SLOPE =  0.0222
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.74
  FLOW VELOCITY(FEET/SEC) =   2.49 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.51   Tc(MIN.) =    8.75
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    602.00 =     522.60 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    602.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.75
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.515
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.50      0.20     0.500    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA AREA(ACRES) =    0.50      SUBAREA RUNOFF(CFS) =    1.54
  EFFECTIVE AREA(ACRES) =      1.00   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.42
  TOTAL AREA(ACRES) =       1.0       PEAK FLOW RATE(CFS) =       3.10

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    603.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    630.00  DOWNSTREAM(FEET) =    608.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   279.50   CHANNEL SLOPE =  0.0787
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.10
  FLOW VELOCITY(FEET/SEC) =   5.30 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.88   Tc(MIN.) =    9.63
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    603.00 =     802.10 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.63
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.330
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        0.47      0.20     0.900    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    1.32
  EFFECTIVE AREA(ACRES) =      1.47   AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.58
  TOTAL AREA(ACRES) =        1.5       PEAK FLOW RATE(CFS) =       4.25

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.25    9.63    3.330  0.20( 0.12) 0.58       1.5     600.00
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    603.00 =     802.10 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.83    9.09    3.440  0.20( 0.14) 0.68       1.2     400.00
      2        3.89    9.86    3.284  0.20( 0.13) 0.67       1.3     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.98    9.09    3.440  0.20( 0.12) 0.62       2.6     400.00
      2        8.12    9.63    3.330  0.20( 0.12) 0.62       2.8     600.00
      3        8.08    9.86    3.284  0.20( 0.12) 0.62       2.8     500.00
    TOTAL AREA(ACRES) =         2.8

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        8.12  Tc(MIN.) =    9.625
  EFFECTIVE AREA(ACRES) =      2.78  AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.62
```

```
  TOTAL AREA(ACRES) =        2.8
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    704.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    608.00  DOWNSTREAM(FEET) =    600.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   260.10   CHANNEL SLOPE =  0.0308
  CHANNEL FLOW THRU SUBAREA(CFS) =      8.12
  FLOW VELOCITY(FEET/SEC) =   4.16 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.04   Tc(MIN.) =   10.67
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    704.00 =    1096.60 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    704.00 TO NODE    704.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.67
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.141
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        0.29      0.20     0.900    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA AREA(ACRES) =    0.29      SUBAREA RUNOFF(CFS) =    0.78
  EFFECTIVE AREA(ACRES) =      3.07   AREA-AVERAGED Fm(INCH/HR) =  0.13
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.65
  TOTAL AREA(ACRES) =        3.1       PEAK FLOW RATE(CFS) =       8.32
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.1  TC(MIN.) =     10.67
  EFFECTIVE AREA(ACRES) =      3.07  AREA-AVERAGED Fm(INCH/HR)=  0.13
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.648
  PEAK FLOW RATE(CFS)   =       8.32

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
```

```
     1        8.18   10.13    3.234  0.20( 0.13) 0.65       2.9     400.00
     2        8.32   10.67    3.141  0.20( 0.13) 0.65       3.1     600.00
     3        8.28   10.90    3.103  0.20( 0.13) 0.65       3.1     500.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

🡅

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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              Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                            Analysis prepared by:

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                                  Suite 400
                                 949-988-5815


 ************************** DESCRIPTION OF STUDY **************************
 * Great Scott - Lake Forest Existing Hydrology                             *
 * Rational Method 2-year storm event                                       *
 * Ryan Kim 2/11/2020 Revised by ATS 10/07/2020, VAA 06/15/2021             *
 **************************************************************************

  FILE NAME: GS2E.DAT
  TIME/DATE OF STUDY: 15:44 06/15/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===   =====  =========  ================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *PIPE MAY BE SIZED TO HAVE A FLOW CAPACITY LESS THAN
   UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   164.30
  ELEVATION DATA: UPSTREAM(FEET) =    650.00  DOWNSTREAM(FEET) =    631.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.364
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.685
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "OPEN BRUSH"               D        0.32      0.20     1.000    67    8.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.42
  TOTAL AREA(ACRES) =      0.32   PEAK FLOW RATE(CFS) =      0.42

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    105.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    631.00  DOWNSTREAM(FEET) =    629.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.60   CHANNEL SLOPE =  0.0360
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.42
  FLOW VELOCITY(FEET/SEC) =   2.84 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.33   Tc(MIN.) =    8.69
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    105.00 =     219.90 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   248.60
  ELEVATION DATA: UPSTREAM(FEET) =    645.00  DOWNSTREAM(FEET) =    638.00
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.215
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.834
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.41      0.20     0.500    57    7.21
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA RUNOFF(CFS) =      0.64
  TOTAL AREA(ACRES) =      0.41   PEAK FLOW RATE(CFS) =      0.64

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    638.00  DOWNSTREAM(FEET) =    630.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   226.50   CHANNEL SLOPE =  0.0353
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.64
  FLOW VELOCITY(FEET/SEC) =   2.82 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.34   Tc(MIN.) =    8.55
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     475.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.55
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.663
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.37      0.20     0.500    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA AREA(ACRES) =    0.37      SUBAREA RUNOFF(CFS) =    0.52
  EFFECTIVE AREA(ACRES) =      0.78   AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.50
  TOTAL AREA(ACRES) =        0.8       PEAK FLOW RATE(CFS) =       1.10

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    503.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
```

```
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    630.00  DOWNSTREAM(FEET) =    610.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   285.20   CHANNEL SLOPE =  0.0701
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.10
  FLOW VELOCITY(FEET/SEC) =   4.04 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.18   Tc(MIN.) =    9.73
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  81
------------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =    9.73
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.545
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "1 DWELLING/ACRE"          D        0.23      0.20     0.800    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.29
  EFFECTIVE AREA(ACRES) =      1.02   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.57
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =       1.31

******************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  11
------------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
==============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.31    9.73    1.545  0.20( 0.11) 0.57       1.0     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.42    8.69    1.648  0.20( 0.20) 1.00       0.3     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    503.00 =     219.90 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.68    8.69    1.648  0.20( 0.14) 0.68       1.2     400.00
```

```
     2        1.70    9.73    1.545  0.20( 0.13) 0.67       1.3     500.00
   TOTAL AREA(ACRES) =        1.3

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        1.70  Tc(MIN.) =    9.730
 EFFECTIVE AREA(ACRES) =      1.33  AREA-AVERAGED Fm(INCH/HR) =  0.13
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.68
 TOTAL AREA(ACRES) =        1.3
 LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    503.00 TO NODE    603.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    610.00  DOWNSTREAM(FEET) =    608.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =    76.20   CHANNEL SLOPE =  0.0262
 CHANNEL FLOW THRU SUBAREA(CFS) =       1.70
 FLOW VELOCITY(FEET/SEC) =   2.70 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   0.47   Tc(MIN.) =   10.20
 LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   297.60
 ELEVATION DATA: UPSTREAM(FEET) =    643.00  DOWNSTREAM(FEET) =    635.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.242
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.830
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  CONDOMINIUMS               D        0.50      0.20     0.350    57    7.24
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      0.80
  TOTAL AREA(ACRES) =      0.50   PEAK FLOW RATE(CFS) =      0.80

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    635.00  DOWNSTREAM(FEET) =    630.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   225.00   CHANNEL SLOPE =  0.0222
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.80
  FLOW VELOCITY(FEET/SEC) =   2.24 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.68   Tc(MIN.) =    8.92
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    602.00 =     522.60 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    602.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.92
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.624
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.50      0.20     0.500    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA AREA(ACRES) =    0.50      SUBAREA RUNOFF(CFS) =    0.69
  EFFECTIVE AREA(ACRES) =      1.00   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.42
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =       1.39

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    603.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    630.00  DOWNSTREAM(FEET) =    608.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   279.50   CHANNEL SLOPE =  0.0787
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.39
  FLOW VELOCITY(FEET/SEC) =   4.48 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.04   Tc(MIN.) =    9.96
```

```
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    603.00 =     802.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.96
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.524
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        0.47      0.20     0.900    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    0.56
  EFFECTIVE AREA(ACRES) =      1.47   AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.58
  TOTAL AREA(ACRES) =        1.5       PEAK FLOW RATE(CFS) =       1.86

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.86    9.96    1.524  0.20( 0.12) 0.58       1.5     600.00
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    603.00 =     802.10 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.68    9.16    1.599  0.20( 0.14) 0.68       1.2     400.00
      2        1.70   10.20    1.503  0.20( 0.13) 0.67       1.3     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.48    9.16    1.599  0.20( 0.13) 0.63       2.6     400.00
      2        3.56    9.96    1.524  0.20( 0.12) 0.62       2.8     600.00
      3        3.54   10.20    1.503  0.20( 0.12) 0.62       2.8     500.00
    TOTAL AREA(ACRES) =         2.8

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        3.56  Tc(MIN.) =    9.958
```

```
  EFFECTIVE AREA(ACRES) =      2.78  AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.63
  TOTAL AREA(ACRES) =        2.8
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    704.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    608.00  DOWNSTREAM(FEET) =    600.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   260.10   CHANNEL SLOPE =  0.0308
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.56
  FLOW VELOCITY(FEET/SEC) =   3.42 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.27   Tc(MIN.) =   11.23
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    704.00 =    1096.60 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    704.00 TO NODE    704.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.23
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.423
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        0.29      0.20     0.900    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA AREA(ACRES) =    0.29      SUBAREA RUNOFF(CFS) =    0.33
  EFFECTIVE AREA(ACRES) =      3.07   AREA-AVERAGED Fm(INCH/HR) =  0.13
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.65
  TOTAL AREA(ACRES) =        3.1       PEAK FLOW RATE(CFS) =       3.57
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.1  TC(MIN.) =     11.23
  EFFECTIVE AREA(ACRES) =      3.07  AREA-AVERAGED Fm(INCH/HR)=  0.13
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.648
  PEAK FLOW RATE(CFS)   =       3.57

  ** PEAK FLOW RATE TABLE **
```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	3.49	10.44	1.484	0.20(0.13)	0.65	2.9	400.00
2	3.57	11.23	1.423	0.20(0.13)	0.65	3.1	600.00
3	3.55	11.47	1.406	0.20(0.13)	0.65	3.1	500.00

==
==

END OF RATIONAL METHOD ANALYSIS

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2014 Advanced Engineering Software (aes)
             Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                           Analysis prepared by:

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                       2603 Main Street, Irvine CA. 92614
                                 Suite 400
                               949-988-5815


 ************************** DESCRIPTION OF STUDY **************************
* Great Scott - Lake Forest Proposed Hydrology                              *
* Rational Method 100-year storm event                                      *
* Ryan Kim 2/11/2020 Revised by ATS 10/07/2020, VAA 06/15/2021             *
 **************************************************************************

  FILE NAME: GS100P.DAT
  TIME/DATE OF STUDY: 08:24 06/16/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *PIPE MAY BE SIZED TO HAVE A FLOW CAPACITY LESS THAN
   UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   238.00
  ELEVATION DATA: UPSTREAM(FEET) =    654.00  DOWNSTREAM(FEET) =    644.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.878
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.769
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "OPEN BRUSH"               D        0.24      0.20     1.000    96   11.88
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.76
  TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      0.76

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    644.00  DOWNSTREAM(FEET) =    641.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   119.00   CHANNEL SLOPE =  0.0252
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.76
  FLOW VELOCITY(FEET/SEC) =   2.38 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =   12.71
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    402.00 =     357.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.71
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.625
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.18      0.20     0.100    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.18      SUBAREA RUNOFF(CFS) =    0.57
  EFFECTIVE AREA(ACRES) =      0.42   AREA-AVERAGED Fm(INCH/HR) =  0.12
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.62
  TOTAL AREA(ACRES) =        0.4       PEAK FLOW RATE(CFS) =       1.31

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    403.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    641.00  DOWNSTREAM(FEET) =    634.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   176.00   CHANNEL SLOPE =  0.0398
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.456
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D        0.04      0.20     0.850    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.36
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.65
  AVERAGE FLOW DEPTH(FEET) =   0.16   TRAVEL TIME(MIN.) =   1.11
  Tc(MIN.) =   13.82
  SUBAREA AREA(ACRES) =     0.04       SUBAREA RUNOFF(CFS) =    0.11
  EFFECTIVE AREA(ACRES) =      0.45     AREA-AVERAGED Fm(INCH/HR) =   0.13
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.64
  TOTAL AREA(ACRES) =        0.5         PEAK FLOW RATE(CFS) =       1.35

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.16   FLOW VELOCITY(FEET/SEC.) =   2.63
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    403.00 =     533.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    404.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   631.00  DOWNSTREAM(FEET) =   627.00
  FLOW LENGTH(FEET) =   342.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.68
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.35
  PIPE TRAVEL TIME(MIN.) =   1.22    Tc(MIN.) =   15.04
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    404.00 =     875.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    404.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    627.00  DOWNSTREAM(FEET) =    615.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.4000
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.35
  FLOW VELOCITY(FEET/SEC) =   5.03 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.10   Tc(MIN.) =   15.13
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    84.00
  ELEVATION DATA: UPSTREAM(FEET) =    642.00  DOWNSTREAM(FEET) =    638.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.13      0.20     0.100    91    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.70
  TOTAL AREA(ACRES) =      0.13   PEAK FLOW RATE(CFS) =      0.70

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    638.00  DOWNSTREAM(FEET) =    636.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    98.00   CHANNEL SLOPE =  0.0173
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.70
```

```
  FLOW VELOCITY(FEET/SEC) =   1.98 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =    5.83
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     182.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    5.83
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.668
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.20      0.20     0.100    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.20      SUBAREA RUNOFF(CFS) =    1.03
  EFFECTIVE AREA(ACRES) =      0.33   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        0.3       PEAK FLOW RATE(CFS) =       1.67

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    503.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    636.30  DOWNSTREAM(FEET) =    627.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   180.00   CHANNEL SLOPE =  0.0489
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.67
  FLOW VELOCITY(FEET/SEC) =   3.67 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.82   Tc(MIN.) =    6.64
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     362.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    6.64
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.257
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.55      0.20     0.100    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.55      SUBAREA RUNOFF(CFS) =    2.58
  EFFECTIVE AREA(ACRES) =      0.88   AREA-AVERAGED Fm(INCH/HR) =  0.02
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        0.9       PEAK FLOW RATE(CFS) =       4.13

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    504.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    627.50  DOWNSTREAM(FEET) =    626.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0075
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.13
  FLOW VELOCITY(FEET/SEC) =   1.75 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.91   Tc(MIN.) =    8.55
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    504.00 =     562.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    504.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.55
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.549
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D        0.68      0.20     0.100    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.68      SUBAREA RUNOFF(CFS) =    2.77
  EFFECTIVE AREA(ACRES) =      1.56   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       6.35

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    504.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.55
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.549
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                 D        0.05      0.20     0.850    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.05      SUBAREA RUNOFF(CFS) =    0.21
  EFFECTIVE AREA(ACRES) =      1.61   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.12
```

```
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       6.56

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    505.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   623.00  DOWNSTREAM(FEET) =   622.00
  FLOW LENGTH(FEET) =    32.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.43
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.56
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    8.60
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    505.00 =     594.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    505.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    622.50  DOWNSTREAM(FEET) =    615.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.2500
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       6.56
  FLOW VELOCITY(FEET/SEC) =   7.12 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.07   Tc(MIN.) =    8.67
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    600.00 =     624.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.56    8.67    4.513  0.20( 0.02) 0.12       1.6     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    600.00 =     624.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.35   15.13    3.280  0.20( 0.13) 0.64       0.5     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.
```

```
  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.64    8.67    4.513  0.20( 0.04) 0.20       1.9     500.00
      2        6.11   15.13    3.280  0.20( 0.05) 0.24       2.1     400.00
    TOTAL AREA(ACRES) =        2.1

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        7.64  Tc(MIN.) =    8.673
  EFFECTIVE AREA(ACRES) =      1.87  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.1
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    506.00 TO NODE    507.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    93.00
  ELEVATION DATA: UPSTREAM(FEET) =    624.60  DOWNSTREAM(FEET) =    623.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.191
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.024
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.24      0.20     0.850    91    7.19
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      1.05
  TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      1.05

****************************************************************************
  FLOW PROCESS FROM NODE    507.00 TO NODE    508.00 IS CODE =  51
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    623.50  DOWNSTREAM(FEET) =    621.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   143.00   CHANNEL SLOPE =  0.0140
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.485
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D        0.04      0.20     0.850    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.12
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.51
  AVERAGE FLOW DEPTH(FEET) =   0.14   TRAVEL TIME(MIN.) =   1.58
  Tc(MIN.) =    8.77
  SUBAREA AREA(ACRES) =     0.04       SUBAREA RUNOFF(CFS) =    0.14
  EFFECTIVE AREA(ACRES) =      0.28     AREA-AVERAGED Fm(INCH/HR) =   0.17
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       1.07

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOW VELOCITY(FEET/SEC.) =   1.51
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    508.00 =     236.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    508.00 TO NODE    509.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   618.50  DOWNSTREAM(FEET) =   617.50
  FLOW LENGTH(FEET) =   158.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.52
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.07
  PIPE TRAVEL TIME(MIN.) =   0.75    Tc(MIN.) =    9.52
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    509.00 =     394.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    509.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    617.50  DOWNSTREAM(FEET) =    615.00
```

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =    72.00   CHANNEL SLOPE =  0.0347
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.07
  FLOW VELOCITY(FEET/SEC) =   2.83 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.42   Tc(MIN.) =    9.94
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    600.00 =     466.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.94
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.174
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D       0.39      0.20     0.850    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.39      SUBAREA RUNOFF(CFS) =    1.42
  EFFECTIVE AREA(ACRES) =      0.67   AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.85
  TOTAL AREA(ACRES) =        0.7       PEAK FLOW RATE(CFS) =       2.41

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.41    9.94    4.174  0.20( 0.17) 0.85       0.7     506.00
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    600.00 =     466.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.64    8.67    4.513  0.20( 0.04) 0.20       1.9     500.00
      2        6.11   15.13    3.280  0.20( 0.05) 0.24       2.1     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.92    8.67    4.513  0.20( 0.07) 0.35       2.5     500.00
      2        9.75    9.94    4.174  0.20( 0.07) 0.37       2.6     506.00
      3        7.98   15.13    3.280  0.20( 0.08) 0.39       2.7     400.00
    TOTAL AREA(ACRES) =         2.7
```

```
  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        9.92  Tc(MIN.) =    8.673
  EFFECTIVE AREA(ACRES) =      2.45  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =        2.7
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   613.00  DOWNSTREAM(FEET) =   612.50
  FLOW LENGTH(FEET) =    95.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.91
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.92
  PIPE TRAVEL TIME(MIN.) =   0.27    Tc(MIN.) =    8.94
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    601.00 =    1000.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    612.50  DOWNSTREAM(FEET) =    600.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   462.00   CHANNEL SLOPE =  0.0271
  CHANNEL FLOW THRU SUBAREA(CFS) =       9.92
  FLOW VELOCITY(FEET/SEC) =   4.10 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.88   Tc(MIN.) =   10.82
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    602.00 =    1462.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.7  TC(MIN.) =     10.82
  EFFECTIVE AREA(ACRES) =      2.45  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.351
  PEAK FLOW RATE(CFS)   =       9.92

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
```

```
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.92   10.82    3.976  0.20( 0.07) 0.35       2.5     500.00
      2        9.75   12.09    3.730  0.20( 0.07) 0.37       2.6     506.00
      3        7.98   17.40    3.028  0.20( 0.08) 0.39       2.7     400.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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             Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                           Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY **************************
* Great Scott - Lake Forest Proposed Hydrology                             *
* Rational Method 25-year storm event                                      *
* Ryan Kim 2/11/2020 Revised by ATS 10/07/2020, VAA 06/15/2021             *
 **************************************************************************

  FILE NAME: GS25P.DAT
  TIME/DATE OF STUDY: 08:30 06/16/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *PIPE MAY BE SIZED TO HAVE A FLOW CAPACITY LESS THAN
   UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   238.00
  ELEVATION DATA: UPSTREAM(FEET) =    654.00  DOWNSTREAM(FEET) =    644.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.878
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.956
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "OPEN BRUSH"               D        0.24      0.20     1.000    83   11.88
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.59
  TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      0.59

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    644.00  DOWNSTREAM(FEET) =    641.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   119.00   CHANNEL SLOPE =  0.0252
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.59
  FLOW VELOCITY(FEET/SEC) =   2.38 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =   12.71
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    402.00 =     357.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.71
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.845
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.18      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.18      SUBAREA RUNOFF(CFS) =    0.45
  EFFECTIVE AREA(ACRES) =      0.42   AREA-AVERAGED Fm(INCH/HR) =  0.12
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.62
  TOTAL AREA(ACRES) =        0.4       PEAK FLOW RATE(CFS) =       1.02

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    403.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    641.00  DOWNSTREAM(FEET) =    634.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   176.00   CHANNEL SLOPE =  0.0398
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.701
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D        0.04      0.20     0.850    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.06
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.41
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   1.22
  Tc(MIN.) =   13.93
  SUBAREA AREA(ACRES) =     0.04       SUBAREA RUNOFF(CFS) =    0.08
  EFFECTIVE AREA(ACRES) =      0.45     AREA-AVERAGED Fm(INCH/HR) =   0.13
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.64
  TOTAL AREA(ACRES) =        0.5         PEAK FLOW RATE(CFS) =       1.05

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOW VELOCITY(FEET/SEC.) =   2.42
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    403.00 =     533.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    404.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   631.00  DOWNSTREAM(FEET) =   627.00
  FLOW LENGTH(FEET) =   342.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.36
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.05
  PIPE TRAVEL TIME(MIN.) =   1.31    Tc(MIN.) =   15.24
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    404.00 =     875.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    404.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    627.00  DOWNSTREAM(FEET) =    615.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.4000
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.05
  FLOW VELOCITY(FEET/SEC) =   4.78 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.10   Tc(MIN.) =   15.34
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    84.00
  ELEVATION DATA: UPSTREAM(FEET) =    642.00  DOWNSTREAM(FEET) =    638.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.824
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.13      0.20     0.100    75    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.54
  TOTAL AREA(ACRES) =      0.13   PEAK FLOW RATE(CFS) =      0.54

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    638.00  DOWNSTREAM(FEET) =    636.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    98.00   CHANNEL SLOPE =  0.0173
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.54
```

```
  FLOW VELOCITY(FEET/SEC) =   1.98 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =    5.83
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     182.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    5.83
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.424
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.20      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.20      SUBAREA RUNOFF(CFS) =    0.80
  EFFECTIVE AREA(ACRES) =      0.33   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        0.3       PEAK FLOW RATE(CFS) =       1.30

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    503.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    636.30  DOWNSTREAM(FEET) =    627.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   180.00   CHANNEL SLOPE =  0.0489
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.30
  FLOW VELOCITY(FEET/SEC) =   3.49 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.86   Tc(MIN.) =    6.69
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     362.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    6.69
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.092
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.55      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.55      SUBAREA RUNOFF(CFS) =    2.01
  EFFECTIVE AREA(ACRES) =      0.88   AREA-AVERAGED Fm(INCH/HR) =  0.02
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        0.9       PEAK FLOW RATE(CFS) =       3.21

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    504.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    627.50  DOWNSTREAM(FEET) =    626.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0075
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.21
  FLOW VELOCITY(FEET/SEC) =   1.65 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.02   Tc(MIN.) =    8.71
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    504.00 =     562.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    504.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.71
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.524
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.68      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.68      SUBAREA RUNOFF(CFS) =    2.14
  EFFECTIVE AREA(ACRES) =      1.56   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       4.91

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    504.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.71
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.524
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D        0.05      0.20     0.850    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.05      SUBAREA RUNOFF(CFS) =    0.16
  EFFECTIVE AREA(ACRES) =      1.61   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.12
```

```
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       5.07

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    505.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   623.00  DOWNSTREAM(FEET) =   622.00
  FLOW LENGTH(FEET) =    32.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.72
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.07
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    8.76
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    505.00 =     594.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    505.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    622.50  DOWNSTREAM(FEET) =    615.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.2500
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       5.07
  FLOW VELOCITY(FEET/SEC) =   6.69 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.07   Tc(MIN.) =    8.83
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    600.00 =     624.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        5.07    8.83    3.495  0.20( 0.02) 0.12       1.6     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    600.00 =     624.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        1.05   15.34    2.558  0.20( 0.13) 0.64       0.5     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.
```

```
  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
      1       5.91    8.83    3.495  0.20( 0.04) 0.20       1.9     500.00
      2       4.75   15.34    2.558  0.20( 0.05) 0.24       2.1     400.00
    TOTAL AREA(ACRES) =        2.1

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        5.91  Tc(MIN.) =    8.835
  EFFECTIVE AREA(ACRES) =      1.87  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.1
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    506.00 TO NODE    507.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    93.00
  ELEVATION DATA: UPSTREAM(FEET) =    624.60  DOWNSTREAM(FEET) =    623.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.191
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.927
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.24      0.20     0.850    75    7.19
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      0.81
  TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      0.81

****************************************************************************
  FLOW PROCESS FROM NODE    507.00 TO NODE    508.00 IS CODE =  51
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    623.50  DOWNSTREAM(FEET) =    621.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   143.00   CHANNEL SLOPE =  0.0140
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.478
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D        0.04      0.20     0.850    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.87
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.39
  AVERAGE FLOW DEPTH(FEET) =   0.12   TRAVEL TIME(MIN.) =   1.72
  Tc(MIN.) =    8.91
  SUBAREA AREA(ACRES) =     0.04       SUBAREA RUNOFF(CFS) =    0.11
  EFFECTIVE AREA(ACRES) =      0.28     AREA-AVERAGED Fm(INCH/HR) =   0.17
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       0.82

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.12   FLOW VELOCITY(FEET/SEC.) =   1.34
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    508.00 =     236.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    508.00 TO NODE    509.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   618.50  DOWNSTREAM(FEET) =   617.50
  FLOW LENGTH(FEET) =   158.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.25
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.82
  PIPE TRAVEL TIME(MIN.) =   0.81    Tc(MIN.) =    9.72
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    509.00 =     394.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    509.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    617.50  DOWNSTREAM(FEET) =    615.00
```

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =    72.00   CHANNEL SLOPE =  0.0347
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =      0.82
  FLOW VELOCITY(FEET/SEC) =   2.80 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.43   Tc(MIN.) =   10.15
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    600.00 =    466.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.15
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.231
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D        0.39      0.20     0.850    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.39      SUBAREA RUNOFF(CFS) =    1.08
  EFFECTIVE AREA(ACRES) =      0.67   AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.85
  TOTAL AREA(ACRES) =        0.7       PEAK FLOW RATE(CFS) =       1.84

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        1.84   10.15    3.231  0.20( 0.17) 0.85       0.7     506.00
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    600.00 =    466.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        5.91    8.83    3.495  0.20( 0.04) 0.20       1.9     500.00
      2        4.75   15.34    2.558  0.20( 0.05) 0.24       2.1     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =    905.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        7.65    8.83    3.495  0.20( 0.07) 0.35       2.5     500.00
      2        7.52   10.15    3.231  0.20( 0.07) 0.37       2.6     506.00
      3        6.19   15.34    2.558  0.20( 0.08) 0.39       2.7     400.00
```

```
    TOTAL AREA(ACRES) =         2.7

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        7.65  Tc(MIN.) =    8.835
  EFFECTIVE AREA(ACRES) =      2.45  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =        2.7
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   613.00  DOWNSTREAM(FEET) =   612.50
  FLOW LENGTH(FEET) =    95.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.47
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.65
  PIPE TRAVEL TIME(MIN.) =   0.29    Tc(MIN.) =    9.12
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    601.00 =    1000.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    612.50  DOWNSTREAM(FEET) =    600.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   462.00   CHANNEL SLOPE =  0.0271
  CHANNEL FLOW THRU SUBAREA(CFS) =       7.65
  FLOW VELOCITY(FEET/SEC) =   3.84 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.00   Tc(MIN.) =   11.13
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    602.00 =    1462.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.7  TC(MIN.) =     11.13
  EFFECTIVE AREA(ACRES) =      2.45  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.351
  PEAK FLOW RATE(CFS)   =       7.65

  ** PEAK FLOW RATE TABLE **
```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	7.65	11.13	3.067	0.20(0.07)	0.35	2.5	500.00
2	7.52	12.45	2.878	0.20(0.07)	0.37	2.6	506.00
3	6.19	17.75	2.355	0.20(0.08)	0.39	2.7	400.00

==
==

END OF RATIONAL METHOD ANALYSIS

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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             Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                           Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY **************************
* Great Scott - Lake Forest Proposed Hydrology                             *
* Rational Method 2-year storm event                                       *
* Ryan Kim 2/11/2020 Revised by ATS 10/07/2020, VAA 06/15/2021             *
 **************************************************************************

  FILE NAME: GS2P.DAT
  TIME/DATE OF STUDY: 08:32 06/16/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *PIPE MAY BE SIZED TO HAVE A FLOW CAPACITY LESS THAN
   UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   238.00
  ELEVATION DATA: UPSTREAM(FEET) =    654.00  DOWNSTREAM(FEET) =    644.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.878
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.378
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "OPEN BRUSH"               D        0.24      0.20     1.000    67   11.88
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.25
  TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      0.25

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    644.00  DOWNSTREAM(FEET) =    641.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   119.00   CHANNEL SLOPE =  0.0252
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.25
  FLOW VELOCITY(FEET/SEC) =   2.38 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =   12.71
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    402.00 =     357.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.71
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.325
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.18      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.18      SUBAREA RUNOFF(CFS) =    0.21
  EFFECTIVE AREA(ACRES) =      0.42   AREA-AVERAGED Fm(INCH/HR) =  0.12
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.62
  TOTAL AREA(ACRES) =        0.4       PEAK FLOW RATE(CFS) =       0.45

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    403.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    641.00  DOWNSTREAM(FEET) =    634.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   176.00   CHANNEL SLOPE =  0.0398
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.237
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D        0.04      0.20     0.850    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.47
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.82
  AVERAGE FLOW DEPTH(FEET) =   0.08   TRAVEL TIME(MIN.) =   1.61
  Tc(MIN.) =   14.32
  SUBAREA AREA(ACRES) =     0.04       SUBAREA RUNOFF(CFS) =    0.04
  EFFECTIVE AREA(ACRES) =      0.45     AREA-AVERAGED Fm(INCH/HR) =   0.13
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.64
  TOTAL AREA(ACRES) =        0.5         PEAK FLOW RATE(CFS) =       0.45

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.08   FLOW VELOCITY(FEET/SEC.) =   1.76
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    403.00 =     533.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    404.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   631.00  DOWNSTREAM(FEET) =   627.00
  FLOW LENGTH(FEET) =   342.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.39
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.45
  PIPE TRAVEL TIME(MIN.) =   1.68    Tc(MIN.) =   16.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    404.00 =     875.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    404.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    627.00  DOWNSTREAM(FEET) =    615.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.4000
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.45
  FLOW VELOCITY(FEET/SEC) =   4.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.11   Tc(MIN.) =   16.11
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    84.00
  ELEVATION DATA: UPSTREAM(FEET) =    642.00  DOWNSTREAM(FEET) =    638.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D       0.13      0.20     0.100    57    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.25
  TOTAL AREA(ACRES) =      0.13   PEAK FLOW RATE(CFS) =      0.25

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    638.00  DOWNSTREAM(FEET) =    636.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    98.00   CHANNEL SLOPE =  0.0173
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
```

```
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.25
  FLOW VELOCITY(FEET/SEC) =   1.98 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =    5.83
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     182.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    5.83
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.073
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.20      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.20      SUBAREA RUNOFF(CFS) =    0.38
  EFFECTIVE AREA(ACRES) =      0.33   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        0.3       PEAK FLOW RATE(CFS) =       0.61

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    503.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    636.30  DOWNSTREAM(FEET) =    627.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   180.00   CHANNEL SLOPE =  0.0489
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.61
  FLOW VELOCITY(FEET/SEC) =   3.32 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.90   Tc(MIN.) =    6.73
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     362.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    6.73
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.909
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.55      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
```

```
  SUBAREA AREA(ACRES) =    0.55      SUBAREA RUNOFF(CFS) =    0.93
  EFFECTIVE AREA(ACRES) =      0.88   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        0.9       PEAK FLOW RATE(CFS) =       1.49

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    504.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    627.50  DOWNSTREAM(FEET) =    626.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0075
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.49
  FLOW VELOCITY(FEET/SEC) =   1.40 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.37   Tc(MIN.) =    9.11
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    504.00 =     562.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    504.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.11
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.605
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D       0.68      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.68      SUBAREA RUNOFF(CFS) =    0.97
  EFFECTIVE AREA(ACRES) =      1.56   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       2.22

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    504.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.11
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.605
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D       0.05      0.20     0.850    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.05      SUBAREA RUNOFF(CFS) =    0.07
```

```
  EFFECTIVE AREA(ACRES) =      1.61   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.12
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       2.29

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    505.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   623.00  DOWNSTREAM(FEET) =   622.00
  FLOW LENGTH(FEET) =    32.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.74
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.29
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    9.18
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    505.00 =     594.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    505.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    622.50  DOWNSTREAM(FEET) =    615.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.2500
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       2.29
  FLOW VELOCITY(FEET/SEC) =   5.60 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.09   Tc(MIN.) =    9.26
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    600.00 =     624.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.29    9.26    1.589  0.20( 0.02) 0.12       1.6     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    600.00 =     624.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.45   16.11    1.157  0.20( 0.13) 0.64       0.5     400.00
```

```
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.66    9.26    1.589  0.20( 0.04) 0.20       1.9     500.00
      2        2.11   16.11    1.157  0.20( 0.05) 0.24       2.1     400.00
    TOTAL AREA(ACRES) =        2.1

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        2.66  Tc(MIN.) =    9.264
  EFFECTIVE AREA(ACRES) =      1.87  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.1
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    506.00 TO NODE    507.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    93.00
  ELEVATION DATA: UPSTREAM(FEET) =    624.60  DOWNSTREAM(FEET) =    623.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.191
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.838
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.24      0.20     0.850    57    7.19
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      0.36
  TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      0.36

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    507.00 TO NODE    508.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    623.50  DOWNSTREAM(FEET) =    621.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   143.00   CHANNEL SLOPE =  0.0140
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.562
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D       0.04      0.20     0.850    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.38
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.01
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   2.35
  Tc(MIN.) =    9.54
  SUBAREA AREA(ACRES) =     0.04       SUBAREA RUNOFF(CFS) =    0.05
  EFFECTIVE AREA(ACRES) =      0.28     AREA-AVERAGED Fm(INCH/HR) =   0.17
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       0.36
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.07   FLOW VELOCITY(FEET/SEC.) =   0.98
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    508.00 =     236.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    508.00 TO NODE    509.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   618.50  DOWNSTREAM(FEET) =   617.50
  FLOW LENGTH(FEET) =   158.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.53
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.36
  PIPE TRAVEL TIME(MIN.) =   1.04    Tc(MIN.) =   10.58
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    509.00 =     394.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    509.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
```

```
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    617.50  DOWNSTREAM(FEET) =    615.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    72.00   CHANNEL SLOPE =  0.0347
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.36
  FLOW VELOCITY(FEET/SEC) =   2.80 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.43   Tc(MIN.) =   11.01
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    600.00 =     466.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.01
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.439
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D        0.39      0.20     0.850    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.39      SUBAREA RUNOFF(CFS) =    0.45
  EFFECTIVE AREA(ACRES) =      0.67   AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.85
  TOTAL AREA(ACRES) =        0.7       PEAK FLOW RATE(CFS) =       0.76

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.76   11.01    1.439  0.20( 0.17) 0.85       0.7     506.00
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    600.00 =     466.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.66    9.26    1.589  0.20( 0.04) 0.20       1.9     500.00
      2        2.11   16.11    1.157  0.20( 0.05) 0.24       2.1     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
```

```
    1        3.38    9.26    1.589  0.20( 0.07) 0.35       2.4     500.00
    2        3.28   11.01    1.439  0.20( 0.07) 0.37       2.6     506.00
    3        2.70   16.11    1.157  0.20( 0.08) 0.39       2.7     400.00
  TOTAL AREA(ACRES) =        2.7

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       3.38  Tc(MIN.) =    9.264
 EFFECTIVE AREA(ACRES) =      2.43  AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.37
 TOTAL AREA(ACRES) =       2.7
 LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   613.00  DOWNSTREAM(FEET) =   612.50
 FLOW LENGTH(FEET) =    95.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.55
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       3.38
 PIPE TRAVEL TIME(MIN.) =   0.35    Tc(MIN.) =    9.61
 LONGEST FLOWPATH FROM NODE    400.00 TO NODE    601.00 =    1000.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    612.50  DOWNSTREAM(FEET) =    600.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   462.00   CHANNEL SLOPE =  0.0271
 CHANNEL FLOW THRU SUBAREA(CFS) =       3.38
 FLOW VELOCITY(FEET/SEC) =   3.17 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   2.43   Tc(MIN.) =   12.04
 LONGEST FLOWPATH FROM NODE    400.00 TO NODE    602.00 =    1462.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        2.7  TC(MIN.) =     12.04
 EFFECTIVE AREA(ACRES) =      2.43  AREA-AVERAGED Fm(INCH/HR)=  0.07
```

AREA-AVERAGED Fp(INCH/HR) = 0.20 AREA-AVERAGED Ap = 0.347
PEAK FLOW RATE(CFS) = 3.38

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	3.38	12.04	1.367	0.20(0.07)	0.35	2.4	500.00
2	3.28	13.81	1.264	0.20(0.07)	0.37	2.6	506.00
3	2.70	19.03	1.051	0.20(0.08)	0.39	2.7	400.00

==
==
END OF RATIONAL METHOD ANALYSIS

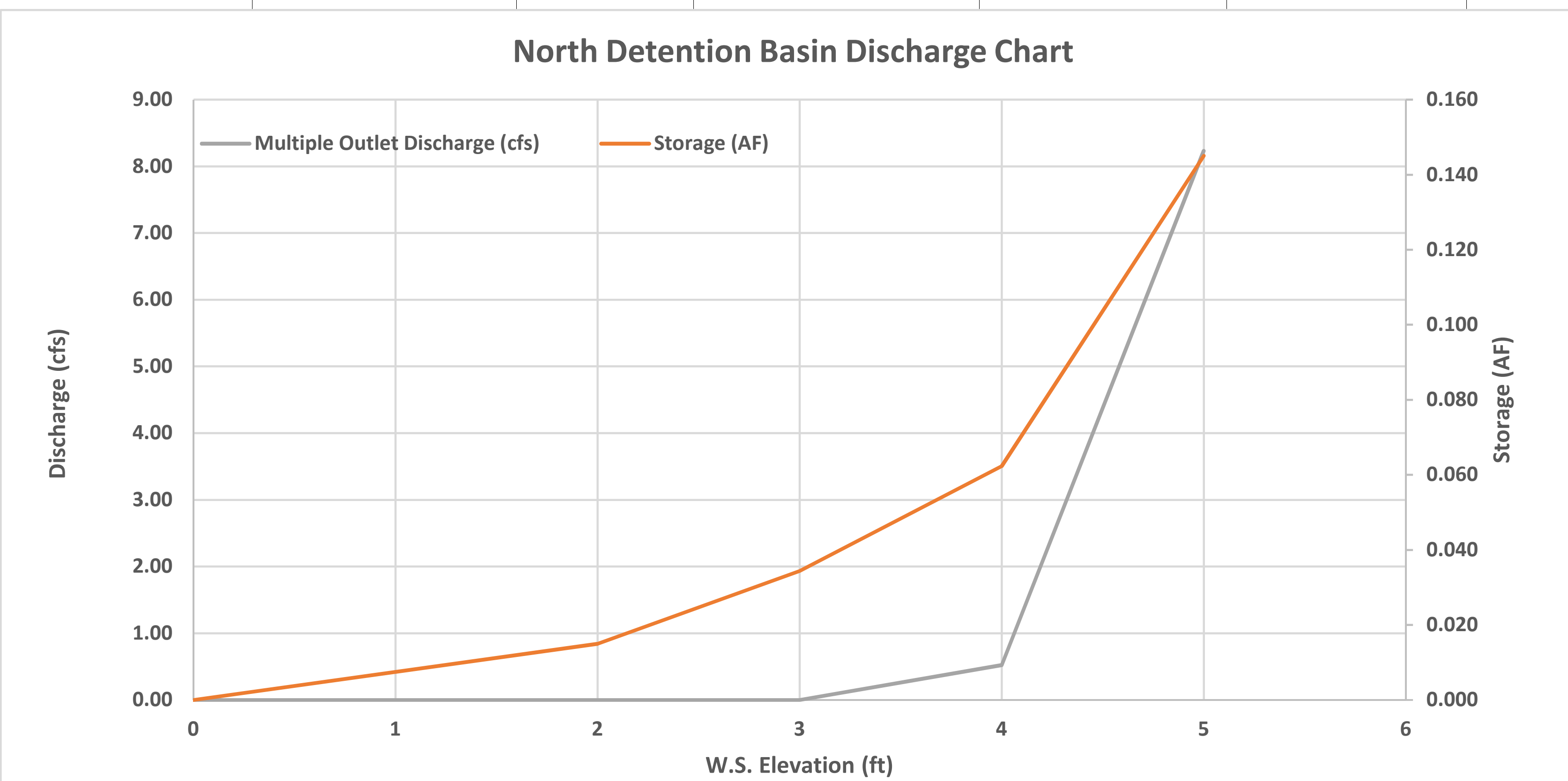
Proposed Detention Basin -100 YR

Stage-Storage-Discharge Table

Stage (ft)	Surface Area (SQFT)	Storage (AF)	Multiple Outlet Discharge (cfs)		
0	5138.00	0.000	0.00		
2	5138.00	0.015	0.00		
3	5138.00	0.034	0.00		
4	5138.00	0.062	0.52	ORIFICE	0
5	5138.00	0.145	8.23	ORIFICE & WEIR	
6	5138.00	0.265	10.76	ORIFICE & WEIR	

ORIFICE DIMS	
L (FT)=	0.33
H (FT)=	0.33
C=	0.6

WEIR DIMS	
L (FT)=	0.25
C=	2.68



```
****************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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                           Analysis prepared by:

                              Huitt-Zollars, Inc.
                      2603 Main Street, Irvine CA. 92614
                                 Suite 400
                                949-988-5815


****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  GREAT SCOTT
  UNIT HYDROGRPAH - EXISTING CONDITION
  100 YR AMC III V.AGUIRRE 06/16/2021
----------------------------------------------------------------------------

    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    3.09
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.148
    LOW LOSS FRACTION = 0.147
    TIME OF CONCENTRATION(MIN.) = 10.48
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.52
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  1.09
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.43
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.36
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  5.63

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.12
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.32

****************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.11      0.0009      0.21  Q         .         .         .         .
  0.28      0.0039      0.21  Q         .         .         .         .
```

0.45	0.0069	0.21	Q	.	.	.	.
0.63	0.0100	0.21	Q	.	.	.	.
0.80	0.0130	0.21	Q	.	.	.	.
0.98	0.0161	0.21	Q	.	.	.	.
1.15	0.0192	0.22	Q	.	.	.	.
1.33	0.0223	0.22	Q	.	.	.	.
1.50	0.0255	0.22	Q	.	.	.	.
1.68	0.0287	0.22	Q	.	.	.	.
1.85	0.0319	0.22	Q	.	.	.	.
2.03	0.0351	0.22	Q	.	.	.	.
2.20	0.0383	0.23	Q	.	.	.	.
2.38	0.0416	0.23	Q	.	.	.	.
2.55	0.0449	0.23	Q	.	.	.	.
2.73	0.0482	0.23	Q	.	.	.	.
2.90	0.0516	0.23	Q	.	.	.	.
3.07	0.0550	0.23	Q	.	.	.	.
3.25	0.0584	0.24	Q	.	.	.	.
3.42	0.0618	0.24	Q	.	.	.	.
3.60	0.0653	0.24	Q	.	.	.	.
3.77	0.0688	0.24	Q	.	.	.	.
3.95	0.0723	0.25	Q	.	.	.	.
4.12	0.0759	0.25	Q	.	.	.	.
4.30	0.0795	0.25	Q	.	.	.	.
4.47	0.0831	0.25	Q	.	.	.	.
4.65	0.0868	0.26	Q	.	.	.	.
4.82	0.0905	0.26	Q	.	.	.	.
5.00	0.0942	0.26	Q	.	.	.	.
5.17	0.0980	0.26	Q	.	.	.	.
5.35	0.1018	0.27	Q	.	.	.	.
5.52	0.1056	0.27	Q	.	.	.	.
5.69	0.1095	0.27	Q	.	.	.	.
5.87	0.1134	0.27	Q	.	.	.	.
6.04	0.1174	0.28	Q	.	.	.	.
6.22	0.1214	0.28	Q	.	.	.	.
6.39	0.1255	0.28	Q	.	.	.	.
6.57	0.1296	0.29	Q	.	.	.	.
6.74	0.1337	0.29	Q	.	.	.	.
6.92	0.1379	0.29	Q	.	.	.	.
7.09	0.1422	0.30	Q	.	.	.	.
7.27	0.1465	0.30	Q	.	.	.	.
7.44	0.1508	0.30	Q	.	.	.	.
7.62	0.1552	0.31	Q	.	.	.	.
7.79	0.1597	0.31	Q	.	.	.	.
7.97	0.1642	0.31	Q	.	.	.	.
8.14	0.1688	0.32	Q	.	.	.	.
8.31	0.1735	0.32	Q	.	.	.	.
8.49	0.1782	0.33	Q	.	.	.	.
8.66	0.1830	0.33	Q	.	.	.	.
8.84	0.1878	0.34	Q	.	.	.	.
9.01	0.1928	0.34	Q	.	.	.	.

```
 9.19      0.1978      0.35  Q          .         .         .         .
 9.36      0.2029      0.35  Q          .         .         .         .
 9.54      0.2080      0.36  Q          .         .         .         .
 9.71      0.2133      0.37  Q          .         .         .         .
 9.89      0.2186      0.37  Q          .         .         .         .
10.06      0.2241      0.38  Q          .         .         .         .
10.24      0.2296      0.39  Q          .         .         .         .
10.41      0.2352      0.39  Q          .         .         .         .
10.59      0.2410      0.40  Q          .         .         .         .
10.76      0.2469      0.41  Q          .         .         .         .
10.93      0.2529      0.42  Q          .         .         .         .
11.11      0.2590      0.43  Q          .         .         .         .
11.28      0.2652      0.44  Q          .         .         .         .
11.46      0.2716      0.45  Q          .         .         .         .
11.63      0.2781      0.46  Q          .         .         .         .
11.81      0.2848      0.47  Q          .         .         .         .
11.98      0.2917      0.48  Q          .         .         .         .
12.16      0.2991      0.54  .Q         .         .         .         .
12.33      0.3076      0.64  .Q         .         .         .         .
12.51      0.3169      0.65  .Q         .         .         .         .
12.68      0.3265      0.67  .Q         .         .         .         .
12.86      0.3363      0.69  .Q         .         .         .         .
13.03      0.3464      0.71  .Q         .         .         .         .
13.21      0.3568      0.73  .Q         .         .         .         .
13.38      0.3675      0.76  .Q         .         .         .         .
13.55      0.3786      0.78  .Q         .         .         .         .
13.73      0.3901      0.82  .Q         .         .         .         .
13.90      0.4021      0.84  .Q         .         .         .         .
14.08      0.4146      0.89  .Q         .         .         .         .
14.25      0.4277      0.92  .Q         .         .         .         .
14.43      0.4415      0.99  .Q         .         .         .         .
14.60      0.4560      1.03  . Q        .         .         .         .
14.78      0.4715      1.12  . Q        .         .         .         .
14.95      0.4880      1.17  . Q        .         .         .         .
15.13      0.5059      1.31  . Q        .         .         .         .
15.30      0.5255      1.40  . Q        .         .         .         .
15.48      0.5465      1.51  .  Q       .         .         .         .
15.65      0.5692      1.63  .  Q       .         .         .         .
15.83      0.5978      2.33  .   Q      .         .         .         .
16.00      0.6385      3.31  .     Q    .         .         .         .
16.17      0.7406     10.83  .          .         .Q        .         .
16.35      0.8324      1.90  .  Q       .         .         .         .
16.52      0.8570      1.51  .  Q       .         .         .         .
16.70      0.8769      1.24  . Q        .         .         .         .
16.87      0.8935      1.07  . Q        .         .         .         .
17.05      0.9081      0.95  .Q         .         .         .         .
17.22      0.9212      0.86  .Q         .         .         .         .
17.40      0.9332      0.80  .Q         .         .         .         .
17.57      0.9443      0.74  .Q         .         .         .         .
17.75      0.9547      0.70  .Q         .         .         .         .
```

```
 17.92      0.9646      0.66  .Q         .         .         .         .
 18.10      0.9739      0.63  .Q         .         .         .         .
 18.27      0.9819      0.48  Q          .         .         .         .
 18.45      0.9886      0.45  Q          .         .         .         .
 18.62      0.9950      0.43  Q          .         .         .         .
 18.79      1.0011      0.41  Q          .         .         .         .
 18.97      1.0069      0.40  Q          .         .         .         .
 19.14      1.0126      0.38  Q          .         .         .         .
 19.32      1.0180      0.37  Q          .         .         .         .
 19.49      1.0233      0.36  Q          .         .         .         .
 19.67      1.0284      0.35  Q          .         .         .         .
 19.84      1.0333      0.34  Q          .         .         .         .
 20.02      1.0381      0.33  Q          .         .         .         .
 20.19      1.0427      0.32  Q          .         .         .         .
 20.37      1.0473      0.31  Q          .         .         .         .
 20.54      1.0517      0.30  Q          .         .         .         .
 20.72      1.0560      0.29  Q          .         .         .         .
 20.89      1.0602      0.29  Q          .         .         .         .
 21.07      1.0643      0.28  Q          .         .         .         .
 21.24      1.0683      0.28  Q          .         .         .         .
 21.41      1.0722      0.27  Q          .         .         .         .
 21.59      1.0761      0.26  Q          .         .         .         .
 21.76      1.0799      0.26  Q          .         .         .         .
 21.94      1.0836      0.25  Q          .         .         .         .
 22.11      1.0872      0.25  Q          .         .         .         .
 22.29      1.0907      0.24  Q          .         .         .         .
 22.46      1.0942      0.24  Q          .         .         .         .
 22.64      1.0977      0.24  Q          .         .         .         .
 22.81      1.1011      0.23  Q          .         .         .         .
 22.99      1.1044      0.23  Q          .         .         .         .
 23.16      1.1077      0.22  Q          .         .         .         .
 23.34      1.1109      0.22  Q          .         .         .         .
 23.51      1.1141      0.22  Q          .         .         .         .
 23.69      1.1172      0.22  Q          .         .         .         .
 23.86      1.1203      0.21  Q          .         .         .         .
 24.03      1.1233      0.21  Q          .         .         .         .
 24.21      1.1248      0.00  Q          .         .         .         .
----------------------------------------------------------------------------
--------------------------------------------------------------------------------
```

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1446.2
10%	125.8
20%	31.4
30%	21.0

```
            40%                                 10.5
            50%                                 10.5
            60%                                 10.5
            70%                                 10.5
            80%                                 10.5
            90%                                 10.5

 Problem Descriptions:
  GREAT SCOTT
  UNIT HYDROGRPAH - PROPOSED CONDITION
  100 YR AMC III V.AGUIRRE 06/16/2021
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    2.73
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.086
    LOW LOSS FRACTION = 0.103
    TIME OF CONCENTRATION(MIN.) = 10.82
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.52
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  1.09
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.43
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.36
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  5.63

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.04
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.24

****************************************************************************
  TIME     VOLUME       Q    0.         2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.13      0.0014      0.19  Q         .         .         .         .
  0.31      0.0043      0.19  Q         .         .         .         .
  0.49      0.0072      0.19  Q         .         .         .         .
  0.67      0.0101      0.20  Q         .         .         .         .
  0.85      0.0131      0.20  Q         .         .         .         .
  1.03      0.0160      0.20  Q         .         .         .         .
  1.21      0.0190      0.20  Q         .         .         .         .
  1.39      0.0220      0.20  Q         .         .         .         .
  1.57      0.0251      0.20  Q         .         .         .         .
  1.75      0.0281      0.21  Q         .         .         .         .
  1.93      0.0312      0.21  Q         .         .         .         .
  2.11      0.0343      0.21  Q         .         .         .         .
```

2.29	0.0374	0.21	Q	.	.	.	.
2.48	0.0406	0.21	Q	.	.	.	.
2.66	0.0437	0.21	Q	.	.	.	.
2.84	0.0470	0.22	Q	.	.	.	.
3.02	0.0502	0.22	Q	.	.	.	.
3.20	0.0534	0.22	Q	.	.	.	.
3.38	0.0567	0.22	Q	.	.	.	.
3.56	0.0601	0.22	Q	.	.	.	.
3.74	0.0634	0.23	Q	.	.	.	.
3.92	0.0668	0.23	Q	.	.	.	.
4.10	0.0702	0.23	Q	.	.	.	.
4.28	0.0736	0.23	Q	.	.	.	.
4.46	0.0771	0.23	Q	.	.	.	.
4.64	0.0806	0.24	Q	.	.	.	.
4.82	0.0842	0.24	Q	.	.	.	.
5.00	0.0878	0.24	Q	.	.	.	.
5.18	0.0914	0.24	Q	.	.	.	.
5.36	0.0950	0.25	Q	.	.	.	.
5.54	0.0987	0.25	Q	.	.	.	.
5.72	0.1025	0.25	.Q	.	.	.	.
5.90	0.1062	0.25	.Q	.	.	.	.
6.08	0.1100	0.26	.Q	.	.	.	.
6.26	0.1139	0.26	.Q	.	.	.	.
6.44	0.1178	0.26	.Q	.	.	.	.
6.62	0.1218	0.27	.Q	.	.	.	.
6.80	0.1258	0.27	.Q	.	.	.	.
6.98	0.1298	0.27	.Q	.	.	.	.
7.16	0.1339	0.28	.Q	.	.	.	.
7.34	0.1380	0.28	.Q	.	.	.	.
7.52	0.1422	0.28	.Q	.	.	.	.
7.70	0.1465	0.29	.Q	.	.	.	.
7.89	0.1508	0.29	.Q	.	.	.	.
8.07	0.1552	0.29	.Q	.	.	.	.
8.25	0.1596	0.30	.Q	.	.	.	.
8.43	0.1641	0.30	.Q	.	.	.	.
8.61	0.1687	0.31	.Q	.	.	.	.
8.79	0.1733	0.31	.Q	.	.	.	.
8.97	0.1780	0.32	.Q	.	.	.	.
9.15	0.1828	0.32	.Q	.	.	.	.
9.33	0.1877	0.33	.Q	.	.	.	.
9.51	0.1926	0.33	.Q	.	.	.	.
9.69	0.1976	0.34	.Q	.	.	.	.
9.87	0.2027	0.35	.Q	.	.	.	.
10.05	0.2079	0.35	.Q	.	.	.	.
10.23	0.2133	0.36	.Q	.	.	.	.
10.41	0.2187	0.37	.Q	.	.	.	.
10.59	0.2242	0.37	.Q	.	.	.	.
10.77	0.2298	0.38	.Q	.	.	.	.
10.95	0.2355	0.39	.Q	.	.	.	.
11.13	0.2414	0.40	.Q	.	.	.	.

```
11.31      0.2474      0.41  .Q        .         .         .         .
11.49      0.2536      0.42  .Q        .         .         .         .
11.67      0.2599      0.43  .Q        .         .         .         .
11.85      0.2663      0.44  .Q        .         .         .         .
12.03      0.2730      0.45  .Q        .         .         .         .
12.21      0.2807      0.58  . Q       .         .         .         .
12.39      0.2895      0.59  . Q       .         .         .         .
12.57      0.2985      0.62  . Q       .         .         .         .
12.75      0.3077      0.63  . Q       .         .         .         .
12.93      0.3173      0.65  . Q       .         .         .         .
13.11      0.3271      0.66  . Q       .         .         .         .
13.30      0.3372      0.69  . Q       .         .         .         .
13.48      0.3477      0.71  . Q       .         .         .         .
13.66      0.3585      0.75  . Q       .         .         .         .
13.84      0.3698      0.77  .  Q      .         .         .         .
14.02      0.3816      0.81  .  Q      .         .         .         .
14.20      0.3939      0.84  .  Q      .         .         .         .
14.38      0.4069      0.90  .  Q      .         .         .         .
14.56      0.4206      0.94  .  Q      .         .         .         .
14.74      0.4352      1.02  .   Q     .         .         .         .
14.92      0.4508      1.07  .   Q     .         .         .         .
15.10      0.4677      1.20  .   Q     .         .         .         .
15.28      0.4862      1.28  .    Q    .         .         .         .
15.46      0.5062      1.41  .    Q    .         .         .         .
15.64      0.5278      1.49  .    Q    .         .         .         .
15.82      0.5549      2.15  .       Q .         .         .         .
16.00      0.5935      3.02  .         . Q       .         .         .
16.18      0.6870      9.53  .         .         .         .       Q .
16.36      0.7710      1.73  .     Q   .         .         .         .
16.54      0.7942      1.38  .    Q    .         .         .         .
16.72      0.8129      1.13  .   Q     .         .         .         .
16.90      0.8286      0.98  .  Q      .         .         .         .
17.08      0.8423      0.87  .  Q      .         .         .         .
17.26      0.8547      0.79  .  Q      .         .         .         .
17.44      0.8660      0.73  . Q       .         .         .         .
17.62      0.8765      0.68  . Q       .         .         .         .
17.80      0.8863      0.64  . Q       .         .         .         .
17.98      0.8956      0.60  . Q       .         .         .         .
18.16      0.9037      0.49  .Q        .         .         .         .
18.34      0.9106      0.43  .Q        .         .         .         .
18.52      0.9169      0.41  .Q        .         .         .         .
18.70      0.9229      0.39  .Q        .         .         .         .
18.89      0.9287      0.38  .Q        .         .         .         .
19.07      0.9342      0.36  .Q        .         .         .         .
19.25      0.9395      0.35  .Q        .         .         .         .
19.43      0.9446      0.34  .Q        .         .         .         .
19.61      0.9496      0.33  .Q        .         .         .         .
19.79      0.9543      0.32  .Q        .         .         .         .
19.97      0.9590      0.31  .Q        .         .         .         .
20.15      0.9635      0.30  .Q        .         .         .         .
```

```
  20.33      0.9679      0.29  .Q        .         .         .         .
  20.51      0.9721      0.28  .Q        .         .         .         .
  20.69      0.9763      0.27  .Q        .         .         .         .
  20.87      0.9803      0.27  .Q        .         .         .         .
  21.05      0.9843      0.26  .Q        .         .         .         .
  21.23      0.9881      0.26  .Q        .         .         .         .
  21.41      0.9919      0.25  .Q        .         .         .         .
  21.59      0.9956      0.25  Q         .         .         .         .
  21.77      0.9992      0.24  Q         .         .         .         .
  21.95      1.0027      0.24  Q         .         .         .         .
  22.13      1.0062      0.23  Q         .         .         .         .
  22.31      1.0096      0.23  Q         .         .         .         .
  22.49      1.0130      0.22  Q         .         .         .         .
  22.67      1.0163      0.22  Q         .         .         .         .
  22.85      1.0195      0.22  Q         .         .         .         .
  23.03      1.0227      0.21  Q         .         .         .         .
  23.21      1.0258      0.21  Q         .         .         .         .
  23.39      1.0289      0.20  Q         .         .         .         .
  23.57      1.0319      0.20  Q         .         .         .         .
  23.75      1.0349      0.20  Q         .         .         .         .
  23.93      1.0379      0.20  Q         .         .         .         .
  24.11      1.0407      0.19  Q         .         .         .         .
  24.30      1.0422      0.00  Q         .         .         .         .
 -----------------------------------------------------------------------------
--------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)

    Percentile of Estimated                 Duration
        Peak Flow Rate                      (minutes)
    =======================                 =========
              0%                             1449.9
             10%                              140.7
             20%                               32.5
             30%                               21.6
             40%                               10.8
             50%                               10.8
             60%                               10.8
             70%                               10.8
             80%                               10.8
             90%                               10.8
=============================================================================
  Problem Descriptions:
   GREAT SCOTT
   FLOOD ROUTING ANALYSIS  - PROPOSED CONDITION
   100 YR AMC III V.AGUIRRE 06/16/2021

=============================================================================
     FLOW-THROUGH DETENTION BASIN MODEL
```

```
     SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
     CONSTANT HYDROGRAPH TIME UNIT(MINUTES) =   10.820
     DEAD STORAGE(AF) =       0.00
     SPECIFIED DEAD STORAGE(AF) FILLED =       0.00
     ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN =    0.00


                    INFLOW
                      |
                      |
                      |
                      V               __effective depth
                -------------          |   (and volume)
                |           |    |     |
                | detention |    |....V.............
                |   basin   |<-->|          outflow
                |           |    |.........__________
                -------------    |         |   \
                      |          | storage |     basin outlet
                      V          -----------
                   OUTFLOW


     DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:
     TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES =   6
     *BASIN-DEPTH  STORAGE    OUTFLOW  **BASIN-DEPTH  STORAGE    OUTFLOW  *
     *   (FEET)  (ACRE-FEET)   (CFS)   **   (FEET)  (ACRE-FEET)   (CFS)   *
     *      0.000      0.000      0.000**      2.000      0.015      0.000*
     *      3.000      0.034      0.000**      4.000      0.062      0.520*
     *      5.000      0.145      8.230**      6.000      0.265     10.760*
----------------------------------------------------------------------------
     BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:
      INTERVAL   DEPTH   {S-O*DT/2}   {S+O*DT/2}
       NUMBER   (FEET)   (ACRE-FEET)  (ACRE-FEET)
           1     0.00       0.00000      0.00000
           2     2.00       0.01500      0.01500
           3     3.00       0.03400      0.03400
           4     4.00       0.05813      0.06587
           5     5.00       0.08367      0.20633
           6     6.00       0.18482      0.34518
     WHERE S=STORAGE(AF);O=OUTFLOW(AF/MIN.);DT=UNIT INTERVAL(MIN.)
----------------------------------------------------------------------------
     DETENTION BASIN ROUTING RESULTS:
     NOTE: COMPUTED BASIN DEPTH, OUTFLOW, AND STORAGE QUANTITIES
           OCCUR AT THE GIVEN TIME. BASIN INFLOW VALUES REPRESENT THE
           AVERAGE INFLOW DURING THE RECENT HYDROGRAPH UNIT INTERVAL.

        TIME  DEAD-STORAGE  INFLOW  EFFECTIVE  OUTFLOW  EFFECTIVE
       (HRS)   FILLED(AF)    (CFS)  DEPTH(FT)   (CFS)   VOLUME(AF)
```

0.131	0.000	0.19	0.38	0.00	0.003
0.311	0.000	0.19	0.77	0.00	0.006
0.491	0.000	0.19	1.16	0.00	0.009
0.672	0.000	0.20	1.55	0.00	0.012
0.852	0.000	0.20	1.94	0.00	0.015
1.032	0.000	0.20	2.13	0.00	0.018
1.213	0.000	0.20	2.29	0.00	0.021
1.393	0.000	0.20	2.45	0.00	0.024
1.573	0.000	0.20	2.61	0.00	0.027
1.754	0.000	0.21	2.77	0.00	0.030
1.934	0.000	0.21	2.93	0.00	0.033
2.114	0.000	0.21	3.06	0.02	0.036
2.295	0.000	0.21	3.14	0.05	0.038
2.475	0.000	0.21	3.21	0.09	0.040
2.655	0.000	0.21	3.26	0.12	0.041
2.836	0.000	0.22	3.30	0.14	0.042
3.016	0.000	0.22	3.33	0.16	0.043
3.196	0.000	0.22	3.35	0.18	0.044
3.377	0.000	0.22	3.37	0.19	0.044
3.557	0.000	0.22	3.38	0.20	0.045
3.737	0.000	0.23	3.40	0.20	0.045
3.918	0.000	0.23	3.41	0.21	0.045
4.098	0.000	0.23	3.41	0.21	0.046
4.278	0.000	0.23	3.42	0.22	0.046
4.459	0.000	0.23	3.43	0.22	0.046
4.639	0.000	0.24	3.44	0.22	0.046
4.819	0.000	0.24	3.44	0.23	0.046
5.000	0.000	0.24	3.45	0.23	0.047
5.180	0.000	0.24	3.45	0.23	0.047
5.360	0.000	0.25	3.46	0.24	0.047
5.541	0.000	0.25	3.46	0.24	0.047
5.721	0.000	0.25	3.47	0.24	0.047
5.901	0.000	0.25	3.47	0.24	0.047
6.082	0.000	0.26	3.48	0.25	0.047
6.262	0.000	0.26	3.48	0.25	0.048
6.442	0.000	0.26	3.49	0.25	0.048
6.623	0.000	0.27	3.49	0.26	0.048
6.803	0.000	0.27	3.50	0.26	0.048
6.983	0.000	0.27	3.51	0.26	0.048
7.164	0.000	0.28	3.51	0.27	0.048
7.344	0.000	0.28	3.52	0.27	0.049
7.524	0.000	0.28	3.53	0.27	0.049
7.705	0.000	0.29	3.53	0.27	0.049
7.885	0.000	0.29	3.54	0.28	0.049
8.065	0.000	0.29	3.55	0.28	0.049
8.246	0.000	0.30	3.55	0.29	0.050
8.426	0.000	0.30	3.56	0.29	0.050
8.606	0.000	0.31	3.57	0.29	0.050
8.787	0.000	0.31	3.58	0.30	0.050

8.967	0.000	0.32	3.59	0.30	0.050
9.147	0.000	0.32	3.59	0.31	0.051
9.328	0.000	0.33	3.60	0.31	0.051
9.508	0.000	0.33	3.61	0.32	0.051
9.688	0.000	0.34	3.62	0.32	0.051
9.869	0.000	0.35	3.63	0.33	0.052
10.049	0.000	0.35	3.64	0.33	0.052
10.229	0.000	0.36	3.66	0.34	0.052
10.410	0.000	0.37	3.67	0.34	0.053
10.590	0.000	0.37	3.68	0.35	0.053
10.770	0.000	0.38	3.69	0.36	0.053
10.951	0.000	0.39	3.71	0.36	0.054
11.131	0.000	0.40	3.72	0.37	0.054
11.311	0.000	0.41	3.74	0.38	0.055
11.492	0.000	0.42	3.75	0.39	0.055
11.672	0.000	0.43	3.77	0.40	0.056
11.852	0.000	0.44	3.79	0.41	0.056
12.033	0.000	0.45	3.81	0.41	0.057
12.213	0.000	0.58	3.88	0.44	0.059
12.393	0.000	0.59	3.95	0.48	0.061
12.574	0.000	0.62	4.00	0.51	0.062
12.754	0.000	0.63	4.01	0.57	0.063
12.934	0.000	0.65	4.02	0.63	0.063
13.115	0.000	0.66	4.02	0.65	0.064
13.295	0.000	0.69	4.02	0.67	0.064
13.475	0.000	0.71	4.02	0.70	0.064
13.656	0.000	0.75	4.03	0.72	0.064
13.836	0.000	0.77	4.03	0.75	0.065
14.016	0.000	0.81	4.04	0.78	0.065
14.197	0.000	0.84	4.04	0.82	0.065
14.377	0.000	0.90	4.05	0.86	0.066
14.557	0.000	0.94	4.05	0.91	0.066
14.738	0.000	1.02	4.06	0.97	0.067
14.918	0.000	1.07	4.07	1.03	0.068
15.098	0.000	1.20	4.08	1.12	0.069
15.279	0.000	1.28	4.10	1.22	0.070
15.459	0.000	1.41	4.11	1.32	0.071
15.639	0.000	1.49	4.12	1.43	0.072
15.820	0.000	2.15	4.20	1.75	0.078
16.000	0.000	3.02	4.30	2.43	0.087
16.180	0.000	9.53	5.01	5.55	0.146
16.361	0.000	1.73	4.32	5.62	0.088
16.541	0.000	1.38	4.15	2.32	0.074
16.721	0.000	1.13	4.09	1.45	0.070
16.902	0.000	0.98	4.07	1.13	0.067
17.082	0.000	0.87	4.05	0.96	0.066
17.262	0.000	0.79	4.04	0.85	0.065
17.443	0.000	0.73	4.03	0.78	0.064
17.623	0.000	0.68	4.02	0.72	0.064
17.803	0.000	0.64	4.02	0.67	0.063

Q100 WSE

Q100 MITIGATED PEAK FLOW

17.984	0.000	0.60	4.01	0.63	0.063
18.164	0.000	0.49	4.00	0.56	0.062
18.344	0.000	0.43	3.96	0.51	0.061
18.525	0.000	0.41	3.92	0.49	0.060
18.705	0.000	0.39	3.88	0.47	0.059
18.885	0.000	0.38	3.84	0.45	0.058
19.066	0.000	0.36	3.81	0.43	0.057
19.246	0.000	0.35	3.77	0.41	0.056
19.426	0.000	0.34	3.74	0.39	0.055
19.607	0.000	0.33	3.71	0.38	0.054
19.787	0.000	0.32	3.69	0.36	0.053
19.967	0.000	0.31	3.66	0.35	0.053
20.148	0.000	0.30	3.64	0.34	0.052
20.328	0.000	0.29	3.62	0.33	0.051
20.508	0.000	0.28	3.60	0.32	0.051
20.689	0.000	0.27	3.58	0.31	0.050
20.869	0.000	0.27	3.57	0.30	0.050
21.049	0.000	0.26	3.55	0.29	0.049
21.230	0.000	0.26	3.54	0.28	0.049
21.410	0.000	0.25	3.52	0.28	0.049
21.590	0.000	0.25	3.51	0.27	0.048
21.771	0.000	0.24	3.50	0.26	0.048
21.951	0.000	0.24	3.49	0.26	0.048
22.131	0.000	0.23	3.48	0.25	0.047
22.312	0.000	0.23	3.47	0.25	0.047
22.492	0.000	0.22	3.46	0.24	0.047
22.672	0.000	0.22	3.45	0.24	0.047
22.853	0.000	0.22	3.44	0.23	0.046
23.033	0.000	0.21	3.43	0.23	0.046
23.213	0.000	0.21	3.42	0.22	0.046
23.394	0.000	0.20	3.42	0.22	0.046
23.574	0.000	0.20	3.41	0.22	0.045
23.754	0.000	0.20	3.40	0.21	0.045
23.935	0.000	0.20	3.40	0.21	0.045
24.115	0.000	0.19	3.39	0.20	0.045

APPENDIX D

Geotechnical Documents

LGC Geotechnical, Inc.

May 28, 2019

Project No. 19035-01

Mr. Jeremy Krout
EPD Solutions, Inc.
2030 Main Street, Suite 1200
Irvine, CA 92614

Subject: ***Preliminary Geotechnical Evaluation and Design Recommendations for Proposed Great Scott Tree Service Development, 20865 Canada Road, Lake Forest, California***

In accordance with your request and authorization, LGC Geotechnical, Inc. has performed a preliminary geotechnical evaluation for the proposed Great Scott Tree Service Development located at 20865 Canada Road in the City of Lake Forest, California. The purpose of our study was to evaluate the existing onsite geotechnical conditions and to provide preliminary geotechnical recommendations relative to the proposed development.

Should you have any questions regarding this report, please do not hesitate to contact our office. We appreciate this opportunity to be of service.

Respectfully Submitted,

LGC Geotechnical, Inc.

REGISTERED PROFESSIONAL ENGINEER RYAN L. DOUGLAS No. 84840 CIVIL STATE OF CALIFORNIA

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RLD/KTM/ala

Distribution: (4) Addressee (3 wet-signed copies and 1 electronic copy)
(4) Great Scott Tree Service, Inc. (electronic copy)
Attn: Mr. Steve Guzowski

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1.0 INTRODUCTION

1.1 Purpose and Scope of Services

This report presents the results of our preliminary geotechnical evaluation for the proposed development located at 20865 Canada Road in the City of Lake Forest, California. Refer to the Site Location Map (Figure 1).

The purpose of our study was to provide a preliminary geotechnical evaluation relative to the proposed development. As part of our scope of work, we have: 1) reviewed available geotechnical background information including in-house regional geologic maps and published geotechnical literature pertinent to the site (Appendix A); 2) performed a limited subsurface geotechnical evaluation of the site consisting of the excavation of three small-diameter borings ranging in depth from approximately 5 to 50 feet below existing ground surface; 3) performed one field infiltration test; 4) performed laboratory testing of select soil samples obtained during our subsurface evaluation; and 5) prepared this geotechnical summary report presenting our preliminary findings, conclusions and recommendations for the development of the proposed project.

1.2 Existing Conditions

The approximately 6.4-acre irregular-shaped site is bound to the north by commercial/industrial developments, to the east by Dimension Drive, to the south by Linear Lane and two existing industrial buildings and to the west by Serrano Creek. Serrano Creek meanders from east to west through the site and is primarily located in the northern region of the site. The site's current use is primarily a residence/farm and vehicular storage yard. The central and western portion of the site contain a residential structure, barn, livestock stables, a horse corral/arena, unpaved and paved roads and miscellaneous debris. The eastern portion of the site contains a manmade lot currently used for vehicular storage. Entry to the site is from either Linear Lane or Canada Road. Vegetation across the site consists of grass, brush, bushes and areas of dense tree growth.

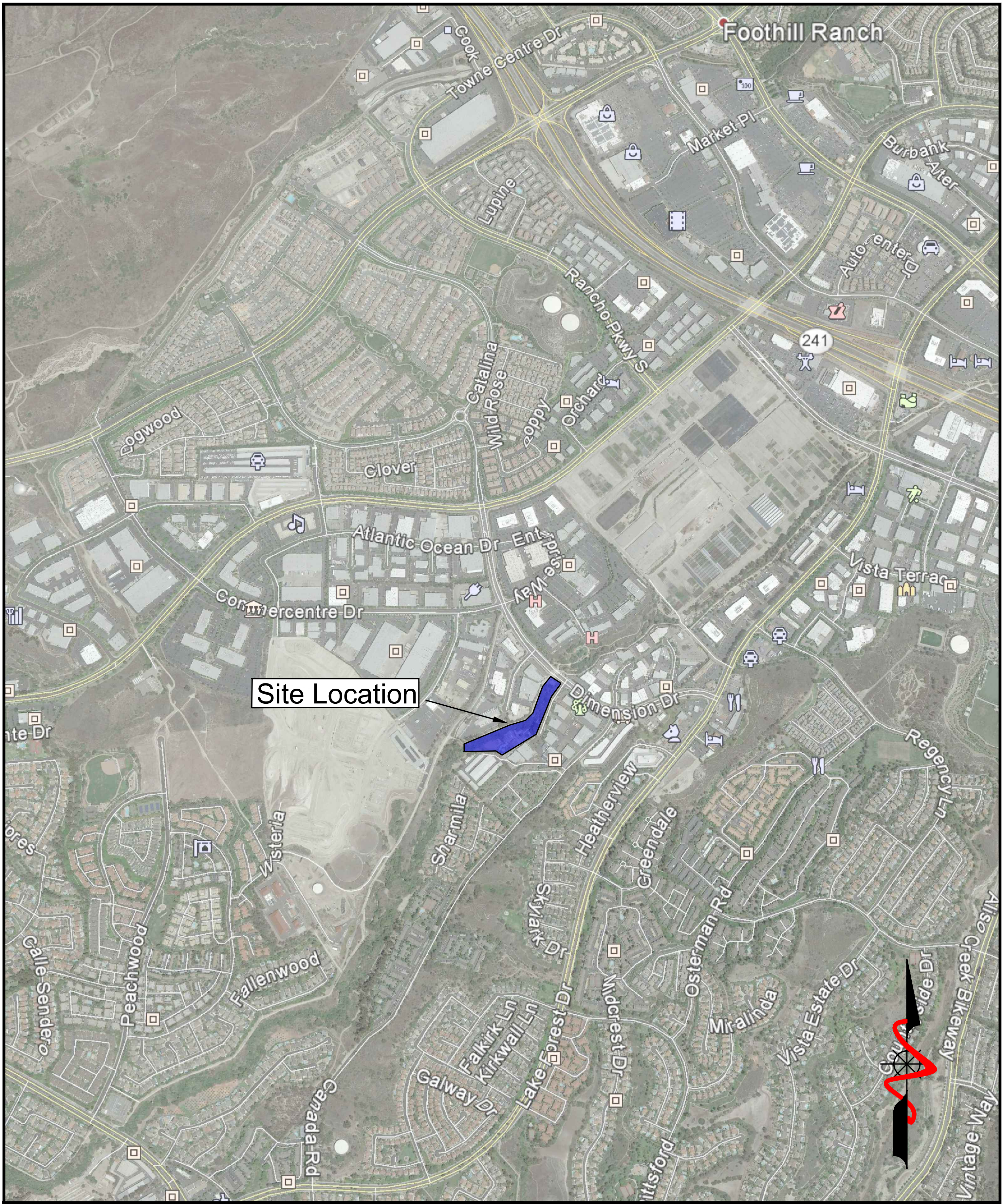
Based on review of historic aerials, it appears the barn structure was constructed some time before the year 1938 and the residential structure was constructed sometime between the years 1946 and 1952.

1.3 Project Description

Based on the conceptual site plan (Herdman, 2018), the proposed improvements include the construction of a restroom building addition, a modular office building, dump truck and boom truck parking areas, vehicular parking areas, a concrete pad for chip drying, freestanding block walls and a water quality basin/feature. The proposed development is located on the southern side of the existing Serrano Creek alignment. Design cuts and fills (not including required remedial grading) are anticipated to be on the order of 2 to 4 feet. The proposed temporary modular structures are anticipated to be relatively light with maximum column and wall loads of approximately 10 kips and 2 kips per linear foot, respectively. Please note no structural loads were provided to us at the time of this report.

Some of the existing structures including the barn (storage building) and residence (office) are anticipated to remain in-place and keep the same building footprint that currently exists.

The recommendations given in this report are based upon the estimated structural loading, grading and layout information above. We understand that the project plans are currently being developed at this time; LGC Geotechnical should be provided with updated project plans and any changes to structural loads when they become available, in order to either confirm or modify the recommendations provided herein.



LGC Geotechnical, Inc.

FIGURE 1
Site Location Map

PROJECT NAME	Great Scott - Lake Forest
PROJECT NO.	19035-01
ENG. / GEOL.	RLD / KTM
SCALE	Not to Scale
DATE	May 2019

1.4 Subsurface Geotechnical Evaluation

LGC Geotechnical performed a limited subsurface geotechnical evaluation of the site consisting of the excavation of three hollow-stem auger borings to evaluate onsite geotechnical conditions.

Three hollow-stem borings (HS-1, HS-2 & I-1) were drilled to depths ranging from approximately 5 to 50 feet below existing grade. An LGC Geotechnical staff engineer observed the drilling operations, logged the borings, and collected soil samples for laboratory testing. The borings were excavated by Calpac Drilling under subcontract to LGC Geotechnical using a truck-mounted drill rig equipped with 8-inch-diameter hollow-stem augers. Driven soil samples were collected by means of the Standard Penetration Test (SPT) and Modified California Drive (MCD) sampler generally obtained at 2.5 to 5-foot vertical increments. The MCD is a split-barrel sampler with a tapered cutting tip and lined with a series of 1-inch-tall brass rings. The SPT sampler (1.4-inch ID) and MCD sampler (2.4-inch ID, 3.0-inch OD) were driven using a 140-pound automatic hammer falling 30 inches to advance the sampler a total depth of 18 inches. The raw blow counts for each 6-inch increment of penetration were recorded on the boring logs. Bulk samples of the near-surface soils were also collected and logged at select borings for laboratory testing. At the completion of drilling, the borings were backfilled with the native soil cuttings and tamped. Some settlement of the backfill soils may occur over time.

Infiltration testing was performed within one of the borings (I-1) to a depth of 5 feet below existing grade. An LGC Geotechnical staff engineer installed standpipe, backfilled the boring with crushed rock and pre-soaked the infiltration hole prior to testing. Infiltration testing was performed per the County of Orange testing guidelines. The location was subsequently backfilled with native soils at the completion of testing.

The approximate locations of our subsurface explorations are provided on the Geotechnical Exploration Location Map (Figure 2). The boring logs are provided in Appendix B.

1.5 Laboratory Testing

Representative bulk and driven (relatively undisturbed) samples were obtained for laboratory testing during our field evaluation. Laboratory testing included in-situ moisture content and in-situ dry density, Atterberg Limits, fines content, expansion index, consolidation, R-value and corrosion (sulfate, chloride, pH and minimum resistivity).

The following is a summary of the laboratory test results:

- Dry density of the samples collected ranged from approximately 91 pounds per cubic foot (pcf) to 117 pcf, with an average of 106 pcf. Field moisture contents ranged from approximately 1 to 26 percent, with an average of 13 percent.
- Four fines content tests were performed and indicated a fines content (passing No. 200 sieve) ranging from approximately 6 to 37 percent. Based on the Unified Soils Classification System (USCS), the tested samples would be classified as "coarse-grained."
- One Atterberg Limit (liquid limit and plastic limit) test was performed. Results indicated a Plasticity Index (PI) value of 17.
- One consolidation test was performed. The load versus deformation plot is provided in

Appendix C.

- Expansion potential testing indicated an expansion index value of 8, corresponding to "Very Low" expansion potential.
- One R-value test was performed on a bulk sample collected and resulted in an R-Value of 66.
- Corrosion testing indicated soluble sulfate contents of approximately 0.02 percent, a chloride content of 103 parts per million (ppm), pH of 8.2, and a minimum resistivity of 857 ohm-centimeters.

A summary of the laboratory test results is presented in Appendix C. The moisture and dry density results are presented on the boring logs in Appendix B.

2.0 GEOTECHNICAL CONDITIONS

2.1 Geologic Conditions

The subject site is located within the foothills of the Santa Ana Mountains, part of the Peninsular Ranges Geomorphic Province. The region consists of dissected foothills bordering the Los Angeles Basin to the northwest and the granite-core Santa Ana Mountains to the east. The Southern California Batholith forms the core of the Santa Ana Mountains, which is overlain by a thick sequence of sedimentary units, which comprise the foothills including the subject site. Late Miocene to Early Pliocene bedrock materials of the Oso Member of the Capistrano Formation that underlie the subject site at depth are primarily composed of sandstone and silty sandstone (USGS, 2004).

The site is specifically located within the Serrano Creek drainage course and the area just southeast of the active drainage. The southwest-flowing creek has deposited variable alluvial materials as observed during our subsurface investigation.

2.2 Generalized Subsurface Conditions

The subsurface evaluation performed at the subject site indicated that site soils consist of variable alluvium ranging from very moist to wet, moderate to dark brown clayey sand and sand, to an alluvial deposit consisting of light gray, relatively dry, medium to coarse sand with few pebbles. The material is labelled "younger alluvium" on boring logs. Bedrock of the Capistrano Formation, Oso Member was encountered at depth below the alluvium, consisting of light yellowish brown, silty sandstone, moist, very dense, observed to the maximum explored depth of approximately 50 feet below existing grade.

It should be noted that the borings are only representative of the location and time where/when they are performed and varying subsurface conditions may exist outside of the performed location. In addition, subsurface conditions can change over time. The soil descriptions provided above should not be construed to mean that the subsurface profile is uniform and that soil is homogeneous within the project area. For details on the stratigraphy at the exploration locations, refer to Appendix B.

2.3 Groundwater

Groundwater was encountered in our boring HS-1 at a depth of approximately 15 feet below existing grade. Historic high groundwater is estimated to be about 10 feet below existing grade (CDMG, 2000).

Seasonal fluctuations of groundwater elevations should be expected over time. In general, groundwater levels fluctuate with the seasons and local zones of perched groundwater may be present due to local seepage caused by irrigation and/or recent precipitation. Local perched groundwater conditions or surface seepage may develop once site development is completed.

2.4 Field Infiltration Testing

One field percolation test was performed in the area of the proposed infiltration trench and the location is depicted on Figure 2 – Geotechnical Exploration Location Map. Test well installation consisted of placing a 3-inch diameter perforated PVC pipe in the excavated borehole and backfilling the annulus with crushed rock including the placement of approximately 2 inches of crushed rock at the bottom of the borehole. The infiltration test well was presoaked the day of installation and testing took place within 24 hours of presoaking. During the pre-test the water level was observed to drop less than 6 inches in 25 minutes for two consecutive readings. Therefore, the test procedure for fine-grained soils or "slow test" was followed. Test well installation and the estimation of infiltration rates were accomplished in general accordance with the guidelines set forth by the County of Orange (2013). In general, three-dimensional flow out of the test well (*percolation*), as observed in the field, is mathematically reduced to one-dimensional flow out of the bottom of the test well (*infiltration*). Infiltration tests are performed using relatively clean water, free of particulates, silt, etc. The results of our recent field infiltration testing are presented in Appendix D and summarized below.

TABLE 1

Summary of Field Infiltration Testing

Infiltration Test Identification	Approx. Depth Below Existing Grade (ft)	Observed Infiltration Rate* (in./hr.)	Measured Infiltration Rate** (in./hr.)
I-1	5	0.7	0.35

*Observed Infiltration Rates Do Not Include Factor of Safety.
**Measured Infiltration Rates Include a Factor of Safety of 2 in Order to Evaluate Feasibility.

The tested infiltration rates provided in this report are considered a general representation of the infiltration rates at the location of the proposed infiltration trench. Please note, the testing of infiltration rates is highly dependent upon the materials encountered at the point of testing (i.e. location and depth of testing). Varying subsurface conditions may exist outside of the test location which could alter the calculated infiltration rate. Please refer to Section 4.6 for subsurface water infiltration recommendations.

2.5 Seismic Design Criteria

The site seismic characteristics were evaluated per the guidelines set forth in Chapter 16, Section 1613 of the 2016 California Building Code (CBC). Since the site contains soils that are susceptible to liquefaction (refer to above Section "Liquefaction and Dynamic Settlement"), ASCE 7 which has been adopted by the CBC requires that site soils be assigned Site Class "F" and a site-specific response spectrum be performed. However, in accordance with Section 20.3.1 of ASCE 7, if the fundamental periods of vibration of the planned structure are equal to or less than 0.5 second, a site-specific response spectrum is not required and ASCE 7/2016 CBC site class and seismic parameters may be used in lieu of a site-specific response spectrum. **It should be noted that the seismic parameters provided herein are not applicable for any structure having a fundamental period of vibration greater than 0.5 second.**

Representative site coordinates of latitude 33.6606 degrees north and longitude -117.6751 degrees west were utilized in our analyses. The maximum considered earthquake (MCE) spectral response accelerations (S_{MS} and S_{M1}) and adjusted design spectral response acceleration parameters (S_{DS} and S_{D1}) for Site Class D are provided in Table 2 below.

TABLE 2

Seismic Design Parameters for Structures with a Period of Vibration ≤ 0.5 Second

Selected Parameters from 2016 CBC, Section 1613 - Earthquake Loads	**Seismic Design Values**
Site Class per Chapter 20 of ASCE 7	D*
Risk-Targeted Spectral Acceleration for Short Periods (S_S)**	1.453g
Risk-Targeted Spectral Accelerations for 1-Second Periods (S_1)**	0.540g
Site Coefficient F_a per Table 1613.3.3(1)	1.0
Site Coefficient F_v per Table 1613.3.3(2)	1.5
Site Modified Spectral Acceleration for Short Periods (S_{MS}) for Site Class D [Note: $S_{MS} = F_a S_S$]	1.453g
Site Modified Spectral Acceleration for 1-Second Periods (S_{M1}) for Site Class D [Note: $S_{M1} = F_v S_1$]	0.811g
Design Spectral Acceleration for Short Periods (S_{DS}) for Site Class D [Note: $S_{DS} = (^2/_3) S_{MS}$]	0.968g
Design Spectral Acceleration for 1-Second Periods (S_{D1}) for Site Class D [Note: $S_{D1} = (^2/_3) S_{M1}$]	0.540g
Mapped Risk Coefficient at 0.2 sec Spectral Response Period, C_{RS} (per ASCE 7)	1.020
Mapped Risk Coefficient at 1 sec Spectral Response Period, C_{R1} (per ASCE 7)	1.052

* Site is Class F, seismic parameters provided herein are only applicable for structure period ≤ 0.5 second, refer to discussion above.

** From SEAOC, 2019

Section 1803.5.12 of the 2016 CBC (per Section 11.8.3 of ASCE 7) states that the maximum considered earthquake geometric mean (MCE_G) Peak Ground Acceleration (PGA) should be used for liquefaction potential. The PGA_M for the site is equal to 0.533g (SEAOC, 2019).

A deaggregation of the PGA based on a 2,475-year average return period indicates that an earthquake magnitude of 6.9 at a distance of approximately 5.4 km from the site would contribute the most to this ground motion (USGS, 2008).

2.6 Faulting

The subject site is not located within a State of California Earthquake Fault Zone (Alquist-Priolo) and no faults were identified on the site during our site evaluation (CGS, 2018). The possibility of damage due to ground rupture is considered low since no active faults are known to cross the site. The closest known active faults are associated with the San Joaquin Hills Fault, located approximately 3.1 miles from the site; the Elsinore Fault Zone, approximately 12.6 miles northeast of the site; and the Newport Inglewood Fault Zone, approximately 12.7 miles southwest of the site.

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the Southern California region, which may affect the site, include ground lurching and shallow ground rupture, soil liquefaction, and dynamic settlement. These secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependent on the distance between the site and causative fault and the onsite geology. A discussion of these secondary effects is provided in the following sections.

2.6.1 Liquefaction and Dynamic Settlement

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions coexist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose near-surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. In general, cohesive soils are not considered susceptible to liquefaction, depending on their plasticity and moisture content (Bray & Sancio, 2006). Effects of liquefaction on level ground include settlement, sand boils, and bearing capacity failures below structures. Dynamic settlement of dry loose sands can occur as the sand particles tend to settle and densify as a result of a seismic event.

Based on our review of the State of California Seismic Hazard Zone for liquefaction potential (CDMG, 2001), the site is located within a liquefaction hazard zone. In general, site soils are medium dense to dense and not susceptible to liquefaction. However, isolated loose sand layers are present and considered susceptible to liquefaction. The recent encountered in-situ groundwater depth of 15 feet below existing grade and historic high groundwater depth of 10 feet below existing grade were both used in the liquefaction analysis. The liquefaction evaluation was performed using data from boring HS-1. Liquefaction potential was evaluated using the procedures outlined by Special Publication 117A (SCEC, 1999 & CGS, 2008) and based on the seismic criteria of the 2016 California Building Code (CBC) and historic high groundwater depth. Liquefaction induced settlement was estimated using the PGA_M per the 2016 CBC and a moment magnitude of 6.9 (USGS, 2008).

Results indicate total seismic settlement on the order of 2-inches or less. Differential seismic settlement can be estimated as half of the total estimated settlement over a horizontal span of about 40 feet (i.e., 1-inch over a horizontal span of 40 feet). Seismically induced settlements were estimated by the procedure outlined by Tokimatsu and Seed (1987). Liquefaction calculations are provided in Appendix E.

2.6.2 Lateral Spreading

Lateral spreading is a type of liquefaction-induced ground failure associated with the lateral displacement of surficial blocks of sediment resulting from liquefaction in a subsurface layer. Once liquefaction transforms the subsurface layer into a fluid mass, gravity plus the earthquake inertial forces may cause the mass to move downslope towards a free face (such as a river channel or an embankment). Lateral spreading may cause large horizontal displacements and such movement typically damages pipelines, utilities, bridges, and structures.

Based on site liquefaction potential, lateral spreading and consequently zones of instability (horizontal displacements) near the banks of the adjacent creek are possible during the design basis earthquake ground motion. A corrected $(N_1)_{60}$ blow count of less than 15 is typically used for screening of potential lateral spreading (Youd, Hansen, Bartlett, 2002). Based on the obtained data, the soils within the lateral zone of the creek generally have corrected $(N_1)_{60}$ values of at least 15. Based on the obtained apparent density (i.e., blow counts) obtained from our field evaluation the potential for lateral spreading is generally considered low.

2.7 Expansion Potential

Based on the results of our recent laboratory testing, site soils are anticipated to have a "Very Low" expansion potential. Final expansion potential of site soils should be determined at the completion of grading. Results of expansion testing at finish grades will be utilized to confirm final foundation design.

3.0 <u>CONCLUSIONS</u>

Based on the results of our geotechnical evaluation, it is our opinion that the proposed development is feasible from a geotechnical standpoint, provided the following conclusions and recommendations are implemented.

The following is a summary of the primary geotechnical factors that may affect future development of the site:

- Groundwater was encountered during our subsurface evaluation at a depth of approximately 15 feet below existing ground surface. Historic high groundwater is estimated to be about 10 feet below existing grade (CDMG, 2000).
- The subject site is not located within a State of California Earthquake Fault Zone (Alquist-Priolo). The main seismic hazard that may affect the site is ground shaking from one of the active regional faults. The subject site will likely experience strong seismic ground shaking during its design life.
- Site soils are considered susceptible to liquefaction. The site is located in a State of California Seismic Hazard Zone for liquefaction. Total dynamic settlement is estimated to be on the order of 2-inches or less. Differential dynamic settlement can be estimated at half of the total settlement over a horizontal span of 40 feet for design of foundations.
- Based on the results of preliminary laboratory testing, site soils are anticipated to have "Very Low" expansion potential. Final design expansion potential must be determined at the completion of grading.
- From a geotechnical perspective, the existing onsite soils are suitable material for use as general fill (not retaining wall backfill), provided that they are relatively free from oversized material (larger than 8 inches in maximum dimension), construction debris, and significant organic material.
- Some portions of the onsite soils have high fines content and are not suitable for backfill of site retaining walls. Therefore, import and/or select grading and stockpiling of onsite sandy soils meeting project recommendations may be required.
- Excavations into the existing site soils should be feasible with heavy construction equipment in good working order.

4.0 PRELIMINARY RECOMMENDATIONS

The following recommendations are to be considered preliminary and should be confirmed upon completion of grading and earthwork operations. In addition, they should be considered minimal from a geotechnical viewpoint, as there may be more restrictive requirements from the architect, structural engineer, building codes, governing agencies, or the owner.

It should be noted that the following geotechnical recommendations are intended to provide sufficient information to develop the site in general accordance with the 2016 CBC requirements. With regard to the potential occurrence of potentially catastrophic geotechnical hazards such as fault rupture, earthquake-induced landslides, liquefaction, etc. the following geotechnical recommendations should provide adequate protection for the proposed development to the extent required to reduce seismic risk to an "acceptable level." The "acceptable level" of risk is defined by the California Code of Regulations as "that level that provides reasonable protection of the public safety, though it does not necessarily ensure continued structural integrity and functionality of the project" [Section 3721(a)]. Therefore, repair and remedial work of the proposed improvements may be required after a significant seismic event. With regards to the potential for less significant geologic hazards to the proposed development, the recommendations contained herein are intended as a reasonable protection against the potential damaging effects of geotechnical phenomena such as expansive soils, fill settlement, groundwater seepage, etc. It should be understood, however, that although our recommendations are intended to maintain the structural integrity of the proposed development and structures given the site geotechnical conditions, they cannot preclude the potential for some cosmetic distress or nuisance issues to develop as a result of the site geotechnical conditions.

The geotechnical recommendations contained herein must be confirmed to be suitable or modified based on the actual as-graded conditions.

4.1 Site Earthwork

We anticipate that earthwork at the site will consist of demolition of the existing site improvements, required earthwork removals, subgrade preparation, precise grading and construction of the proposed new improvements including the modular buildings, parking areas, subsurface utilities, water quality facilities, etc.

We recommend that earthwork be performed in accordance with the following recommendations, future grading plan review report(s), the 2016 CBC/City of Lake Forest grading requirements, and the General Earthwork and Grading Specifications included in Appendix F. In case of conflict, the following recommendations shall supersede those included in Appendix F. The following recommendations should be considered preliminary and may be revised based upon future evaluation and review of the project plans and/or based on the actual conditions encountered during site grading/construction.

4.1.1 Site Preparation

Prior to grading of areas to receive structural fill or engineered improvements, the areas should be cleared of existing building structures, asphalt, surface obstructions, and demolition debris. Vegetation and debris should be removed and properly disposed of off-site. Holes resulting from the removal of buried obstructions, which extend below proposed finish grades, should be replaced with suitable compacted fill material. Any abandoned sewer or storm drain lines should be completely removed and replaced with properly placed compacted fill. Deeper demolition may be required in order to remove existing foundations. We recommend the trenches associated with demolition which extend below the remedial grading depth be backfilled and properly compacted prior to the demolition contractor leaving the site.

If cesspools or septic systems are encountered during earthwork, they should be removed in their entirety. The resulting excavation should be backfilled with properly compacted fill soils. As an alternative, cesspools can be backfilled with lean sand-cement slurry. Any encountered wells should be properly abandoned in accordance with regulatory requirements. At the conclusion of the clearing operations, a representative of LGC Geotechnical should observe and accept the site prior to further grading.

4.1.2 Removal and Recompaction Depths and Limits

In order to provide a relatively uniform bearing condition for the planned building structures and improvements, we recommend the site soils be removed and recompacted.

Buildings: We recommend that soils within the proposed building addition areas and modular building pads be removed and recompacted to a minimum depth of 4 feet below existing grade or 3 feet beneath the base of the foundations, whichever is deeper. Where adequate space is available, the base of removal and recompaction bottoms should extend laterally a minimum distance equal to the depth of removal and recompaction below finish grade or at a minimum distance of 4 feet beyond the edges of the proposed building foundations, whichever is larger.

Minor Site Structures: For minor site structures such as free-standing, screen walls, trash enclosures, etc., removal and recompaction should extend at least 3 feet beneath the existing grade or 2 feet beneath the base of foundations, whichever is deeper. In general, the envelope for removal and recompaction should extend laterally a minimum distance of 3 feet beyond the edges of the proposed improvements mentioned above, where space permits.

Pavement and Hardscape: Within pavement areas, removal and recompaction should extend to a depth of at least 1 foot below the existing grade or 1 foot beneath the finished subgrade (i.e., beneath planned aggregate base/asphalt concrete or gravel). Within hardscape areas, removal and recompaction should extend to a depth of at least 1 foot below the existing grade or 1 foot beneath the finished subgrade (i.e., beneath planned concrete).

Local conditions may be encountered during excavation that could require deep remedial grading beyond the above noted minimum in order to obtain an acceptable subgrade. The actual depths and lateral extents of grading will be determined by the geotechnical consultant, based on subsurface conditions encountered during grading. Removal and recompaction areas should be accurately staked in the field by the Project Surveyor.

4.1.3 Temporary Excavations

Temporary excavations should be performed in accordance with project plans, specifications, and all Occupational Safety and Health Administration (OSHA) requirements. Excavations should be laid back or shored in accordance with OSHA requirements before personnel or equipment are allowed to enter. Based on our field investigation, the majority of site soils are anticipated to be OSHA Type "B" soils (refer to the attached boring logs). Sandy soils are present and should be considered susceptible to caving. Raveling of the sandy soils should be anticipated for temporary slopes. Flatter slope inclinations should be considered if raveling cannot be tolerated. The exposed slope surface may be kept surficially moist (but not saturated) during construction to reduce (not eliminate) potential sloughing. Soil conditions should be regularly evaluated during construction to verify conditions are as anticipated. The contractor shall be responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Close coordination with the geotechnical consultant should be maintained to facilitate construction while providing safe excavations. Excavation safety is the sole responsibility of the contractor.

Surcharge loads (vehicular traffic, soil stockpiles, construction equipment, etc.) should be set back from the perimeter of excavations a minimum distance equivalent to a 1:1 projection from the bottom of the excavation or 5 feet, whichever is greater, unless the cut is properly shored and designed for the applicable surcharge load. Once an excavation has been initiated, it should be backfilled as soon as practical. Prolonged exposure of temporary excavations may result in some localized instability. Excavations should be planned so that they are not initiated without sufficient time to shore/fill them prior to weekends, holidays, or forecasted rain.

It should be noted that any excavation that extends below a 1:1 (horizontal to vertical) projection of an existing foundation will remove existing support of the structure foundation. If requested, temporary shoring parameters will be provided.

4.1.4 Removal Bottoms and Subgrade Preparation

In general, removal bottoms and areas to receive compacted fill should be scarified to a minimum depth of 6 inches, brought to a near-optimum moisture condition (generally within optimum and 2 percent above optimum moisture content), and re-compacted per project recommendations.

Removal bottoms and areas to receive fill should be observed and accepted by the geotechnical consultant prior to subsequent fill placement. Soil subgrade for planned footings and improvements (e.g., slabs, etc.) should be firm and competent.

4.1.5 Material for Fill

From a geotechnical perspective, the onsite soils are generally considered suitable for use as general compacted fill, provided they are screened of significant organic materials, construction debris and oversized material (8 inches in greatest dimension).

From a geotechnical viewpoint, any required import soils for general fill (i.e., non-retaining wall backfill) should consist of soils of "Very Low" expansion potential (expansion index 20 or less based on American Society for Testing and Materials [ASTM] D 4829), and free of significant organic materials, construction debris and any material greater than 3 inches in maximum dimension. Import for any required retaining wall backfill should meet the criteria outlined in the following paragraph. Source samples should be provided to the geotechnical consultant for laboratory testing a minimum of four working days prior to any planned importation.

Retaining wall backfill should consist of imported or onsite free draining, clean granular (sandy) soils with a maximum of 35 percent fines (passing the No. 200 sieve) per ASTM Test Method D1140 (or ASTM D6913/D422) and a "Very Low" expansion potential (EI of 20 or less per ASTM D4829). Soils should also be screened of significant organic materials, construction debris, and any material greater than 3 inches in maximum dimension. The site contains soils that are not suitable for retaining wall backfill due to their fines content; therefore, select grading and stockpiling and/or import of soils meeting the criteria outlined above will be required by the contractor for obtaining suitable retaining wall backfill soil. These preliminary findings should be confirmed during grading.

Aggregate base (crushed aggregate base or crushed miscellaneous base) should conform to the requirements of Section 200-2 of the most recent version of the Standard Specifications for Public Works Construction ("Greenbook") for untreated base materials (except processed miscellaneous base) and/or City of Lake Forest requirements.

The placement of inert demolition materials in compacted fill is acceptable from a geotechnical viewpoint provided the demolition material is broken up into pieces not larger than typically used for aggregate base (approximately 1-inch in maximum dimension) and well blended into fill soils with essentially no resulting voids. Demolition material placed in fills must be free of construction debris (wood, organics, etc.) and reinforcing steel. If asphalt concrete fragments will be incorporated into the demolition materials, approval from an environmental viewpoint may be required and is not the purview of the geotechnical consultant. From our previous experience, we recommend that asphalt concrete fragments be limited to fill areas within planned parking and drive aisle areas (i.e., not within building pad areas).

4.1.6 Placement and Compaction of Fills

Material to be placed as fill should be brought to near-optimum moisture content (generally within optimum and 2 percent above optimum moisture content) and recompacted to at least 90 percent relative compaction (per ASTM D1557). Moisture conditioning of site soils will be required in order to achieve adequate compaction. Drying and or mixing of very moist soils will be required prior to reusing the materials in compacted fills. Soils are also present that will require additional moisture in order to achieve the required compaction.

The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in compacted thickness. Each lift should be thoroughly compacted and accepted prior to subsequent lifts. Generally, placement and compaction of fill should be performed in accordance with local grading ordinances and with observation and testing performed by the geotechnical consultant. Oversized material as previously defined should be removed from site fills.

During backfill of excavations, the fill should be properly benched into firm and competent soils of temporary backcut slopes as it is placed in lifts.

Aggregate base material should be compacted to at least 95 percent relative compaction at or slightly above optimum moisture content per ASTM D1557. Subgrade below aggregate base should be compacted to at least 90 percent relative compaction per ASTM D1557 at near-optimum moisture content (generally within optimum and 2 percent above optimum moisture content).

4.1.7 <u>Trench and Retaining Wall Backfill and Compaction</u>

The onsite soils may generally be suitable as trench backfill, provided the soils are screened of rocks, construction debris, other material greater than 6 inches in diameter and significant organic matter. If trenches are shallow or the use of conventional equipment may result in damage to the utilities, sand having a sand equivalent (SE) of 30 or greater (per California Test Method [CTM] 217) may be used to bed and shade the pipes. Based on our field evaluation, onsite soils will not meet this sand equivalent requirement. Sand backfill within the pipe bedding zone may be densified by jetting or flooding and then tamping to ensure adequate compaction. Subsequent trench backfill should be compacted in uniform lifts (as outlined above in section "Placement and Compaction of Fills") by mechanical means to at least 90 percent relative compaction (per ASTM D1557).

Utility trenches running parallel to footings should not be excavated within a 1:1 (horizontal to vertical) downward projection from adjacent footings ("footing influence zone") to avoid potential undermining. Depending on the utility line and structural loading of the footing, utility trenches running perpendicular to footings may require special provisions such as sand-cement slurry backfill of the utility trench in this zone or flexible sleeves through the footings. These conditions should be evaluated on a case-by-case basis.

Retaining wall backfill should consist of sandy soils as outlined in preceding Section 4.1.5. The limits of select sandy backfill should extend at minimum ½ the height of the retaining wall or the width of the heel (if applicable), whichever is greater (Figure 3). Retaining wall backfill soils should be compacted in relatively uniform thin lifts to at least 90 percent relative compaction (per ASTM D1557). Jetting or flooding of retaining wall backfill materials should not be permitted.

In backfill areas where mechanical compaction of soil backfill is impractical due to space constraints, typically sand-cement slurry may be substituted for compacted backfill. The slurry should contain about one sack of cement per cubic yard. When set, such a mix typically has the consistency of compacted soil. Sand cement slurry placed near the surface within landscape areas should be evaluated for potential impacts on planned improvements.

A representative from LGC Geotechnical should observe, probe, and test the backfill to verify compliance with the project recommendations.

4.2 *Preliminary Foundation Recommendations*

The proposed building additions and modular structures may be supported on a conventional slab and spread footings or a mat slab, provided earthwork is performed in accordance with the recommendations presented in this report. All footings should be supported on properly compacted fill. Please note that the following foundation recommendations are preliminary and must be confirmed by LGC Geotechnical at the completion of grading.

Preliminary foundation recommendations are provided in the following sections. The foundation design must be performed by the structural engineer based on the following geotechnical parameters and minimum values provided.

4.2.1 *Slab Design and Construction*

We recommend building additions be founded on a conventional slab with a minimum thickness of 4 inches. We recommend the prefabricated modular buildings (office structures, etc.) be founded on a mat slab a minimum thickness of 6 inches. Conventional slabs and mat slabs are to be supported on compacted fill soils properly prepared in accordance with the recommendations provided in this report. Minimum slab reinforcement should be determined by the structural engineer based on the imposed loading, crack control, etc.

It is recommended that subgrade soils below mat slabs be moisture conditioned in order to maintain the recommended moisture content up to the time of concrete placement. The recommended moisture content of the mat slab subgrade soils should be approximately 0 to 4 percent above optimum moisture content to a minimum depth of 12 inches. The moisture content of the mat slab subgrade should be verified by the geotechnical engineer within 1 to 2 days prior to concrete placement. In addition, this moisture content should be maintained around the immediate perimeter of the mat slabs during construction.

4.2.2 Slab Underlayment Guidelines

The following is for informational purposes only since slab underlayment (e.g., moisture retarder, sand or gravel layers for concrete curing and/or capillary break) is unrelated to the geotechnical performance of the foundation and thereby not the purview of the geotechnical consultant. Post-construction moisture migration should be expected below the foundation. The foundation engineer should determine whether the use of a capillary break (sand or gravel layer), in conjunction with the vapor retarder, is necessary or required by code. Sand layer thickness and location (above and/or below vapor retarder) should also be determined by the foundation engineer/architect.

4.3 Soil Bearing and Lateral Resistance

Provided our earthwork recommendations are implemented, an allowable soil bearing pressure of 2,000 pounds per square foot (psf) may be used for the design of footings having a minimum width of 12 inches and minimum embedment of 12 inches below lowest adjacent ground surface. These allowable bearing pressures are applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. Bearing values indicated are for total dead loads and frequently applied live loads and may be increased by ⅓ for short duration loading (i.e., wind or seismic loads).

In utilizing the above-mentioned allowable bearing capacity and provided our earthwork recommendations are implemented, foundation settlement due to structural loads is anticipated to be ½-inch or less. Differential settlement may be taken as half of the total settlement (i.e., ¼-inch over a horizontal span of 40 feet).

Resistance to lateral loads can be provided by friction acting at the base of foundations and by passive earth pressure. For concrete/soil frictional resistance, an allowable coefficient of friction of 0.3 may be assumed with dead-load forces. For slabs constructed over a moisture retarder, the allowable friction coefficient should be provided by the manufacturer. An allowable passive lateral earth pressure of 225 psf per foot of depth (or pcf) to a maximum of 2,250 psf may be used for lateral resistance. Allowable passive pressure may be increased to 300 pcf to a maximum of 3,000 psf for short duration seismic or wind loading. These passive pressures are applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. For a 2:1 (horizontal to vertical) downward sloping condition, a reduced allowable passive lateral earth pressure of 100 pcf to a maximum of 1,000 psf may be used. We recommend that the upper foot of passive resistance be neglected if finished grade will not be covered with concrete or asphalt. Frictional resistance and passive pressure may be used in combination without reduction. The provided allowable passive pressures are based on a factor of safety of 1.5 and 1.1 for static and seismic loading conditions, respectively. The structural designer should incorporate appropriate factors of safety and/or load factors in their design.

4.4 Lateral Earth Pressures for Retaining Walls

The following may be used for design of site retaining walls. Lateral earth pressures are provided as equivalent fluid unit weights, in psf per foot of depth (or pcf). These values do not contain an appreciable factor of safety, so the retaining wall designer should apply the applicable factors of safety and/or load factors during design. A soil unit weight of 120 pcf may be assumed for calculating the actual weight of soil over the wall footing.

The following lateral earth pressures are presented in Table 3 for approved import or onsite free draining, clean granular (sandy) soils with a maximum of 35 percent fines (passing the No. 200 sieve per ASTM D-421/422) and a "Very Low" expansion potential (EI of 20 or less per ASTM D4829). Portions of the onsite soils are not suitable for retaining wall backfill due to their fines content. Therefore, select grading and stockpiling and/or import of soils meeting the criteria outlined above will be required by the contractor for obtaining suitable retaining wall backfill soil. The wall designer should clearly indicate on the retaining wall plans the required select sandy soil backfill criteria. These preliminary findings should be confirmed during grading.

TABLE 3

Lateral Earth Pressures – Approved Sandy Soils

Conditions	**Equivalent Fluid Unit Weight (pcf)**	**Equivalent Fluid Unit Weight (pcf)**
	Level Backfill	**2:1 Sloped Backfill**
	Approved Sandy Soils	**Approved Sandy Soils**
Active	35	55
At-Rest	55	70

If the wall can yield enough to mobilize the full shear strength of the soil, it can be designed for "active" pressure. If the wall cannot yield under the applied load, the earth pressure will be higher. This would include 90-degree corners of retaining walls. Such walls should be designed for "at-rest." The equivalent fluid pressure values assume free-draining conditions and a drainage system will be installed and maintained to prevent the build-up of hydrostatic pressures. If conditions other than those assumed above are anticipated, the equivalent fluid pressure values should be provided on an individual-case basis by the geotechnical engineer.

Retaining wall structures should be provided with appropriate drainage and appropriately waterproofed. To reduce, but not eliminate, saturation of near-surface (upper approximate 1-foot) soils in front of the retaining walls, the perforated subdrain pipe should be located as low as possible behind the retaining wall. The outlet pipe should be sloped to drain to a suitable outlet. In general, we do not recommend retaining wall outlet pipes be connected to area drains. If subdrains are connected to area drains, special care should be taken to maintain these drains. Typical conventional retaining wall drainage is shown on Figure 3. It should be noted that the recommended subdrain does not provide protection against seepage through the face of the wall and/or efflorescence. Waterproofing and outlet systems are not the purview of the geotechnical consultant.

Surcharge loading effects from any adjacent structures should be evaluated by the retaining wall designer. In general, structural loads within a 1:1 (horizontal: vertical) upward projection from the bottom of the proposed retaining wall footing will surcharge the proposed retaining wall. In addition to the recommended earth pressure, retaining walls adjacent to streets should be designed to resist a uniform lateral pressure of 85 pounds per square foot (psf) due to normal street vehicle traffic, if applicable. Uniform lateral surcharges may be estimated using the applicable coefficient of lateral earth pressure using a rectangular distribution. A factor of 0.45 and 0.3 may be used for at-rest and active conditions, respectively. The retaining wall designer should contact the geotechnical consultant for any required geotechnical input in estimating surcharge loads.

If required, the retaining wall designer may use a seismic lateral earth pressure increment of 10 pcf for a level backfill condition. This increment should be applied in addition to the provided static lateral earth pressure using a triangular distribution with the resultant acting at H/3 in relation to the base of the retaining structure (where H is the retained height). Per Section 1803.5.12 of the 2016 CBC, the seismic lateral earth pressure is applicable to structures assigned to Seismic Design Category D through F for retaining wall structures supporting more than 6 feet of backfill height. The provided seismic lateral earth pressure should not be used for retaining walls exceeding 10 feet in height. If a retaining wall greater than 10 feet in height is proposed or a retaining wall with a sloping backfill condition, the retaining wall designer should contact the geotechnical engineer for specific seismic lateral earth pressure increments based on the configuration of the planned retaining wall structures. This seismic lateral earth pressure is estimated using the procedure outlined by the Structural Engineers Association of California (Lew, et al, 2010).

Soil bearing and lateral resistance (friction coefficient and passive resistance) are provided in Section 4.3 (Soil Bearing and Lateral Resistance). Earthwork considerations (temporary backcuts, backfill, compaction, etc.) for retaining walls are provided in Section 4.1 (Site Earthwork) and the subsequent earthwork related sub-sections.

4.5 Soil Corrosivity

Although not corrosion engineers (LGC Geotechnical is not a corrosion consultant), several governing agencies in Southern California require the geotechnical consultant to determine the corrosion potential of soils to buried concrete and metal facilities. We therefore present the results of our testing with regard to corrosion for the use of the client and other consultants, as they determine necessary.

Corrosion testing of a near-surface bulk sample indicated a soluble sulfate content less than approximately 0.02 percent, a chloride content of 103 parts per million (ppm), pH of 8.2, and a minimum resistivity of 857 ohm-centimeters. Based on Caltrans Corrosion Guidelines (Caltrans, 2015), soils are considered corrosive to structural elements if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm (0.2 percent) or greater. Based on the preliminary test results, soils are not considered corrosive using Caltrans criteria.

Based on laboratory sulfate test results, the near surface soils are designated to a class “S0” per ACI 318, Table 19.3.1.1 with respect to sulfates. Concrete in direct contact with the onsite soils can be designed according to ACI 318, Table 19.3.2.1 using the “S0” sulfate classification.

Laboratory testing may need to be performed at the completion of grading by the project corrosion engineer to further evaluate the as-graded soil corrosivity characteristics.

Accordingly, revision of the corrosion potential may be needed, should future test results differ substantially from the conditions reported herein. The client and/or other members of the development team should consider this during the design and planning phase of the project and formulate an appropriate course of action.

4.6 ***Control of Surface Water and Drainage Control***

From a geotechnical perspective, we recommend that compacted finished grade soils adjacent to the proposed warehouse structures be sloped away from the proposed structures towards an approved drainage device or unobstructed swale. Drainage swales, wherever feasible, should not be constructed within 5 feet of buildings. Where lot and building geometry necessitates that the drainage swales be routed closer than 5 feet to structural foundations, we recommend the use of area drains together with drainage swales. Drainage swales used in conjunction with area drains should be designed by the project civil engineer so that a properly constructed and maintained system will prevent ponding within 5 feet of the foundation. Code compliance of grades is not the purview of the geotechnical consultant.

Planters with open bottoms adjacent to buildings should be avoided. Planters should not be designed adjacent to buildings unless provisions for drainage, such as catch basins, liners, and/or area drains, are made. Overwatering must be avoided.

4.7 ***Subsurface Water Infiltration***

Recent regulatory changes in some jurisdictions have recommended that low flow runoff be infiltrated rather than discharged via conventional storm drainage systems. In general, the vast majority of geotechnical distress issues are directly related to improper drainage. In general, distress in the form of movement of improvements could occur as a result of soil saturation and loss of soil support, expansion, internal soil erosion, collapse and/or settlement. Infiltrated water may enter underground utility pipe zones and migrate along the pipe backfill, potentially impacting other improvements located far away from the point of infiltration.

Geotechnical stability and integrity of the project site is reliant upon appropriate handling of surface water. Due to the low infiltration rate, shallow groundwater and site liquefaction potential, we strongly recommend against the intentional infiltration of storm water.

4.8 ***Preliminary Asphalt Concrete Pavement Sections***

The following provisional minimum asphalt concrete (AC) street sections are provided in Table4 for Traffic Indices (TI) of 5.5, 6.0 and 6.5 to be utilized in the design of the auto and truck parking/circulation areas. These sections are based on an assumed R-value of 50. These recommendations must be confirmed with R-value testing of representative near-surface soils at the completion of grading and after underground utilities have been installed and backfilled. Final pavement sections should be confirmed by the project civil engineer based upon the final design Traffic Index. If requested, LGC Geotechnical will provide sections for alternate TI values.

TABLE 4

Preliminary Asphalt Concrete Pavement Section Options

Assumed Traffic Index	5.5	6.0	6.5
R -Value Subgrade	50	50	50
AC Thickness	4.0 inches	4.0 inches	4.0 inches
Aggregate Base Thickness	4.0 inches	4.0 inches	4.5 inches

The pavement section thicknesses provided above are considered minimum thicknesses. Increasing the thickness of any or all of the above layers will reduce the likelihood of the pavement experiencing distress during its service life. The above recommendations are based on the assumption that proper maintenance and irrigation of the areas adjacent to the roadway will occur throughout the design life of the pavement. Failure to maintain a proper maintenance and/or irrigation program may jeopardize the integrity of the pavement.

Earthwork recommendations regarding aggregate base and subgrade are provided in the previous Section "Site Earthwork" and the related sub-sections of this report.

4.9 Preliminary Gravel Parking Area Recommendations

It is our understanding that the equipment parking areas will consist of compacted gravel (1-inch to 1 ½-inch) over compacted subgrade and asphalt concrete paving is not desired. A minimum of 4 inches of compacted gravel over compacted subgrade is recommended.

The thickness shown is a minimum thickness. Increasing the thickness of the above will reduce the likelihood of the equipment parking area experiencing distress during its service life. The above recommendations are based on the assumption that proper maintenance and irrigation of the areas adjacent to the equipment parking areas will occur through the design life of the pavement. Failure to maintain a proper maintenance and/or irrigation program may jeopardize the integrity of the equipment parking areas.

Earthwork recommendations regarding aggregate base and subgrade are provided in the previous Section "Site Earthwork" and the related sub-sections of this report.

4.10 Nonstructural Concrete Flatwork

Nonstructural concrete flatwork (such as walkways, patio slabs, etc.) has a potential for cracking due to changes in soil volume related to soil-moisture fluctuations. To reduce the potential for excessive cracking and lifting, concrete may be designed in accordance with the minimum guidelines outlined in Table 5. These guidelines will reduce the potential for irregular cracking and promote cracking along construction joints, but will not eliminate all cracking or lifting. Thickening the concrete and/or adding additional reinforcement will further reduce cosmetic distress.

TABLE 5

Preliminary Geotechnical Parameters for Nonstructural Concrete Flatwork Placed on Very Low to Low Expansion Potential Subgrade

	Sidewalks	Private Drives	Patios/ Entryways	City Sidewalk Curb and Gutters
Minimum Thickness (in.)	4 (nominal)	4 (full)	4 (full)	City/Agency Standard
Presoaking	Wet down prior to placing	Wet down prior to placing	Wet down prior to placing	City/Agency Standard
Reinforcement	—	No. 3 at 24 inches on centers	No. 3 at 24 inches on centers	City/Agency Standard
Thickened Edge (in.)	—	8 x 8	—	City/Agency Standard
Crack Control Joints	Saw cut or deep open tool joint to a minimum of $^{1}/_{3}$ the concrete thickness	Saw cut or deep open tool joint to a minimum of $^{1}/_{3}$ the concrete thickness	Saw cut or deep open tool joint to a minimum of $^{1}/_{3}$ the concrete thickness	City/Agency Standard
Maximum Joint Spacing	5 feet	10 feet or quarter cut whichever is closer	6 feet	City/Agency Standard
Aggregate Base Thickness (in.)	—	—	—	City/Agency Standard

4.11 Geotechnical Plan Review

When available, project plans (grading, foundation, retaining wall, etc.) should be reviewed by this office prior to construction to verify that our geotechnical recommendations have been incorporated. Additional field work and/or modified geotechnical recommendations may be necessary.

4.12 Geotechnical Observation and Testing During Construction

The recommendations provided in this report are based on limited subsurface observations and geotechnical analysis. The interpolated subsurface conditions should be checked in the field during construction by a representative of LGC Geotechnical. Geotechnical observation and testing is required per Section 1705 of the 2016 California Building Code (CBC).

Geotechnical observation and/or testing should be performed by LGC Geotechnical at the following stages:

- During grading (removal and recompaction bottoms, fill placement, etc.);
- During retaining wall backfill and compaction;
- During utility trench backfill and compaction;
- After moisture conditioning building pads and other concrete-flatwork subgrades, and prior to placement of aggregate base or concrete;
- Preparation of pavement subgrade and placement of aggregate base;
- After building and wall footing excavation and prior to placing steel reinforcement and/or concrete; and
- When any unusual soil conditions are encountered during any construction operation subsequent to issuance of this report.

5.0 LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable soils engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

This report is based on data obtained from limited observations of the site, which have been extrapolated to characterize the site. While the scope of services performed is considered suitable to adequately characterize the site geotechnical conditions relative to the proposed development, no practical evaluation can completely eliminate uncertainty regarding the anticipated geotechnical conditions in connection with a subject site. Variations may exist and conditions not observed or described in this report may be encountered during grading and construction.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the other consultants (at a minimum the civil engineer, structural engineer, landscape architect) and incorporated into their plans. The contractor should properly implement the recommendations during construction and notify the owner if they consider any of the recommendations presented herein to be unsafe, or unsuitable.

The findings of this report are valid as of the present date. However, changes in the conditions of a site can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. The findings, conclusions, and recommendations presented in this report can be relied upon only if LGC Geotechnical has the opportunity to observe the subsurface conditions during grading and construction of the project, in order to confirm that our preliminary findings are representative for the site. This report is intended exclusively for use by the client, any use of or reliance on this report by a third party shall be at such party's sole risk.

In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and modification.

LEGEND

Propo□ed Location of Hollo□ Stem Boring by LGC Geotechnical□ □ith Appro□imate Propo□ed Depth in □eet

Propo□ed Location of Hollo□ Stem Auger Infiltration Boring by LGC Geotechnical□□ith Appro□imate Propo□ed Depth in □eet

LGC Geotechnical, Inc.
131 Calle Iglesia, Ste. 200
San Clemente, CA 92672
TEL (949) 369-6141 FAX (949) 369-6142

FIGURE 2
Geotechnical Exploration Location Map

PROJECT NAME	Great Scott - Lake Forest
PROJECT NO.	19035-01
ENG. / GEOL.	RLD / KTM
SCALE	Not to Scale
DATE	May 2019

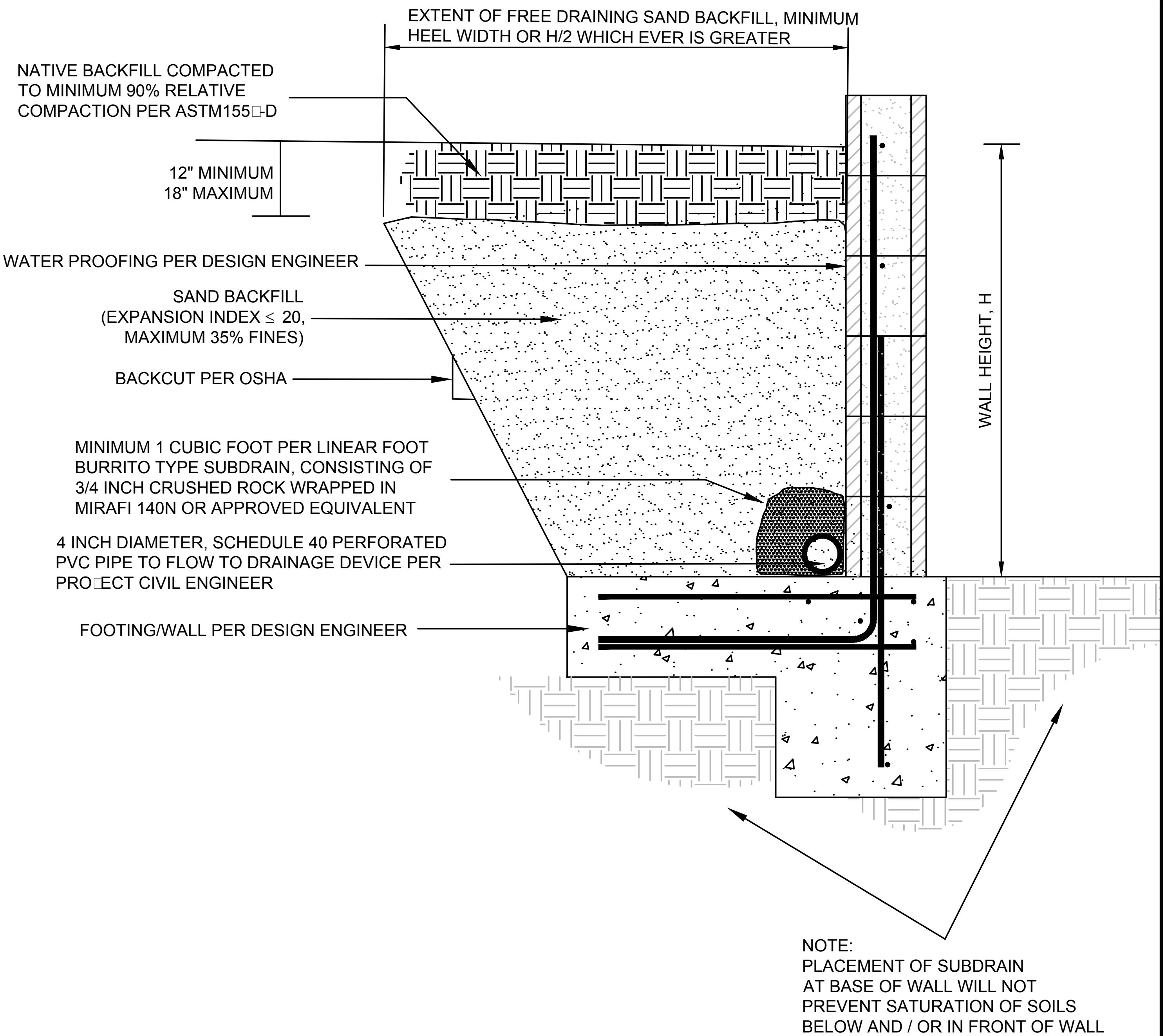


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FIGURE 3
Retaining Wall Detail

PROJECT NAME	Great Scott - Lake Forest
PROJECT NO.	19035-01
ENG.	RLD
SCALE	Not to Scale
DATE	May 2019

Appendix A
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APPENDIX A

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Appendix B
Field Exploration Logs

Geotechnical Boring Log Borehole HS-1

Date: 4/8/2019	**Drilling Company:** Cal Pac
Project Name: Great Scott - Lake Forest	**Type of Rig:** Track Rig
Project Number: 19035-01	**Drop:** 30" **Hole Diameter:** 8"
Elevation of Top of Hole: ~631' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 1 of 2

Logged By BPP
Sampled By BPP
Checked By RLD

Elevation (ft)	Depth (ft)	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	0	B-1				SP-SC	**@0' to □0' - Quaternary Alluvium (Qal)**	
630							@0' - Silty SAND: dark brown, slightly moist	EI,CR
		R-1	5 6 6	111.8	12.1	SM	@2.5' - Silty SAND: gray, moist, loose	
625	5	R-2	2 3 3	98.2	14.2		@5' - Silty SAND: brown, very moist, loose	
		R-3	2 4 □	112.2	14.6	SC	@□.5' - Clayey SAND: dark olive brown, very moist, loose	CN
620	10	R-4	2 2 3	101.8	21.8		@10' - Clayey SAND: brown, very moist, loose	-#200
615	15	SPT-1	2 2 3		26.2	CL	@15' - Sandy CLAY: brown, wet, medium stiff□ groundwater	AL
610	20	R-5	11 12 11	112.□	15.1	SP-SM	@20' - SAND with Silt: light brown, wet, medium dense	-#200
605	25	SPT-2	5 11 12		18.4	SM	@25' - Silty SAND: brown, wet, medium dense	-#200
	30						**@□0' to T.D. - Tertiary Capi□trano □ormation□□ □o Member (Tco)**	

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:
- B BULK SAMPLE
- R RING SAMPLE (CA Modified Sampler)
- G GRAB SAMPLE
- SPT STANDARD PENETRATION TEST SAMPLE
- GROUNDWATER TABLE

TEST TYPES:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- SA SIEVE ANALYSIS
- S&H SIEVE AND HYDROMETER
- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 4/25/2019

Geotechnical Boring Log Borehole HS-1

Date: 4/8/2019	**Drilling Company:** Cal Pac
Project Name: Great Scott - Lake Forest	**Type of Rig:** Track Rig
Project Number: 19035-01	**Drop:** 30" **Hole Diameter:** 8"
Elevation of Top of Hole: ~631' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 2 of 2

Logged By BPP
Sampled By BPP
Checked By RLD

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
600	30		R-6	9 11 22	11□.0	14.5	SC	@30' - Clayey SAND with some gravel: gray-brown, wet, medium dense□e□tremely weathered bedrock	-#200
595	35		SPT-3	3 11 2□		1□.2	SM	@35' - Silty SAND: yellowish brown, wet, dense	
590	40		R-□	50/2"	105.4	24.8	SC	@40' - Clayey SAND: gray-brown with iron o□ide staining, wet, very dense□slightly weathered bedrock	
585	45		SPT-4	50/6"		1□.5		@45' - Clayey SAND: gray with iron o□ide staining, wet, very dense @4□' - Auger Refusal	
580	50							Total Depth = 50' Groundwater Encountered at Appro□imately 15' Backfilled with Cuttings on 4/8/2019	
5□5	55								
	60								

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- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Geotechnical Boring Log Borehole HS-□

Date: 4/8/2019	**Drilling Company:** Cal Pac
Project Name: Great Scott - Lake Forest	**Type of Rig:** Track Rig
Project Number: 19035-01	**Drop:** 30" **Hole Diameter:** 8"
Elevation of Top of Hole: ~646' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 1 of 1

Logged By BPP
Sampled By BPP
Checked By N/A

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
645	0	B-1					SM	**@0' to T.D. - Quaternary Young Alluvium (Qya)** @0' - Silty SAND with Gravel: brown and dry	RV
			R-1	8 8 12	105.6	0.8	SP	@2.5' - SAND: pinkish-brown, dry, medium dense	
640	5		R-2	□ □ 9	100.0	2.4		@5' - SAND: light brown, dry, medium dense	
			R-3	□ 9 12	103.0	1.1		@□.5' - SAND: yellowish brown, dry, medium dense	
635	10		R-4	□ 13 14	91.4	0.□		@10' - SAND: pinkish gray, dry, medium dense	
630	15							Total Depth = 10' Groundwater Not Encountered Backfilled with Cuttings on 4/8/2019	
625	20								
620	25								
	30								

Geotechnical, Inc.

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- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 4/25/2019

Geotechnical Boring Log Borehole I-1

Date: 4/8/2019	**Drilling Company:** Cal Pac
Project Name: Great Scott - Lake Forest	**Type of Rig:** Track Rig
Project Number: 19035-01	**Drop:** 30" **Hole Diameter:** 8"
Elevation of Top of Hole: ~630' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 1 of 1

Logged By BPP
Sampled By BPP
Checked By N/A

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	0						SM	**@0' to T.D. - Quaternay Alluvium (Qal)**	
								@0' - Silty SAND: brown and moist	
			R-1	2 2 3	110.6	10.2		@2.5' - Silty SAND: gray-brown, wet, very loose	
625	5							Total Depth = 5' Groundwater Not Encountered Backfilled with Cuttings on 4/8/2019	
620	10								
615	15								
610	20								
605	25								
	30								

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:
- B BULK SAMPLE
- R RING SAMPLE (CA Modified Sampler)
- G GRAB SAMPLE
- SPT STANDARD PENETRATION TEST SAMPLE
- GROUNDWATER TABLE

TEST TYPES:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- SA SIEVE ANALYSIS
- S&H SIEVE AND HYDROMETER
- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 4/25/2019

Appendix C
Laboratory Test Results

APPENDIX C

Laboratory Test Results

The laboratory testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soils. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of the test type and a table summarizing the test results.

<u>Moisture and Density Determination Tests</u>: Moisture content (ASTM D2216) and dry density determinations (ASTM D2937) were performed on driven samples obtained from the test borings. The results of these tests are presented in the boring logs. Where applicable, only moisture content was determined from SPT or disturbed samples.

<u>Grain Size Distribution/Fines Content</u>: Representative samples were dried, weighed, and soaked in water until individual soil particles were separated (per ASTM D421) and then washed on a No. 200 sieve (ASTM D1140). Where applicable, the portion retained on the No. 200 sieve was dried and then sieved on a U.S. Standard brass sieve set in accordance with ASTM D6913 (sieve) or ASTM D422 (sieve and hydrometer).

Sample Location	Description	% Passing # 200 Sieve
HS-1 @ 10 ft	Clayey Sand	37
HS-1 @ 20 ft	Sand with Silt	6
HS-1 @ 25 ft	Silty Sand	16
HS-1 @ 30 ft	Clayey Sand with some Gravel	37

<u>Atterberg Limits</u>: The liquid and plastic limits ("Atterberg Limits") were determined per ASTM D4318 for engineering classification of fine-grained material and presented in the table below. The USCS soil classification indicated in the table below is based on the portion of sample passing the No. 40 sieve and may not necessarily be representative of the entire sample. The plot is provided in this Appendix.

Sample Location	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	USCS Soil Classification
HS-1 @ 15 ft	35	18	17	CL

Laboratory Test Results

Consolidation: One consolidation test was performed per ASTM D2435. A sample (2.4 inches in diameter and 1 inch in height) was placed in a consolidometer and increasing loads were applied. The sample was allowed to consolidate under "double drainage" and total deformation for each loading step was recorded. The percent consolidation for each load step was recorded as the ratio of the amount of vertical compression to the original sample height. The consolidation pressure curve is provided in this Appendix.

Expansion Index: The expansion potential of a selected representative sample was evaluated by the Expansion Index Test per ASTM D4829.

Sample Location	**Expansion Index**	**Expansion Potential***
HS-1 @ 1-5 ft	8	Very Low

* Per ASTM D4829

R-value Test: R-value test was performed in general accordance with California Test Method 301. The plot is included in the Appendix.

Sample Location	**R-value**
HS-2 @ 1-5 ft	66

Soluble Sulfates: The soluble sulfate content of a selected sample was determined by standard geochemical methods (CTM 417). The test results are presented in the table below.

Sample Location	**Sulfate Content (%)**
HS-1 @ 1-5 ft	< 0.02

Chloride Content: Chloride content was tested per CTM 422. The results are presented below.

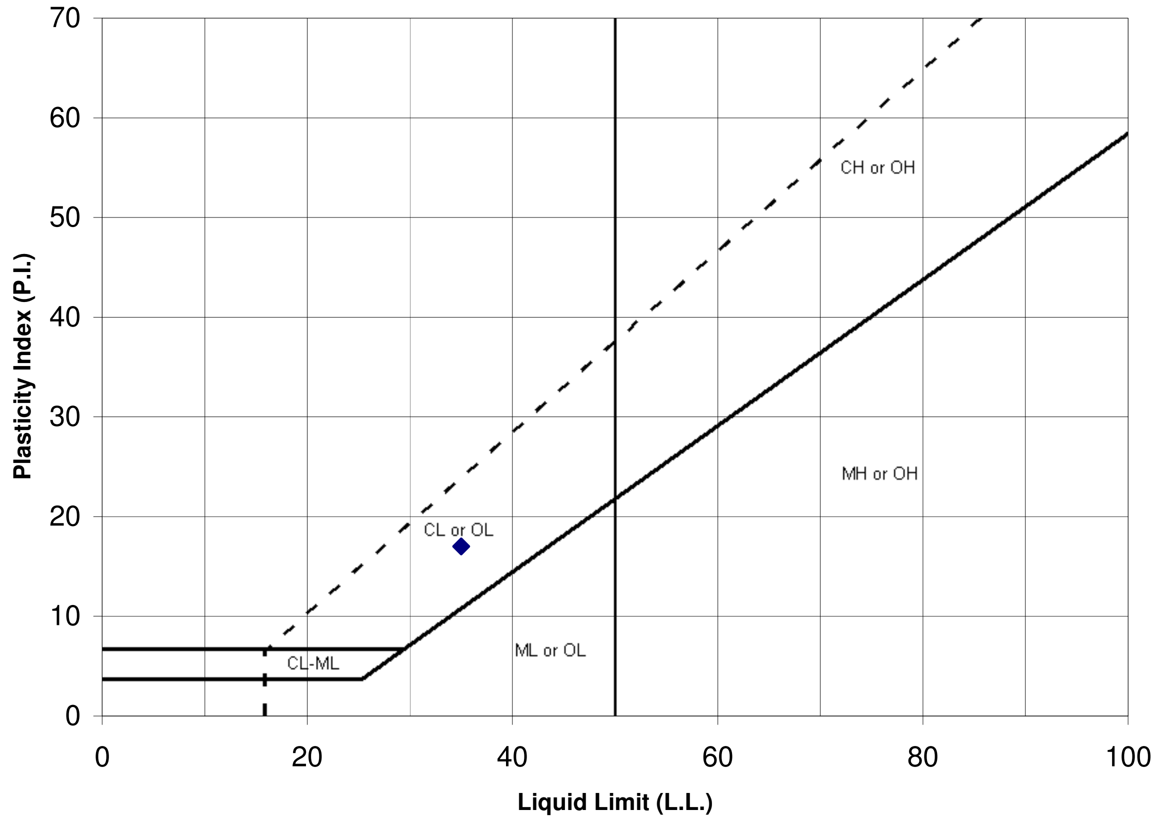
Sample Location	**Chloride Content (ppm)**
HS-1 @ 1-5 ft	103

Laboratory Test Results

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with CTM 643 and standard geochemical methods. The results are presented in the table below.

Sample Location	pH	Minimum Resistivity (ohms-cm)
HS-1 @ 1-5 ft	8.2	857

PLASTICITY CHART - CLASSIFICATION OF FINE-GRAINED SOILS



Symbol	Location.:	Sample No.:	Depth (ft)	Passing No. 200 Sieve (%)	Liquid Limit (%) LL	Plastic Limit (%) PL	Plasticity Index (%) PI	USCS
◆	HS-1	SPT-1	15	-	35	18	17	CL

LGC Geotechnical, Inc.

ATTERBERG LIMITS
(ASTM D 4318)

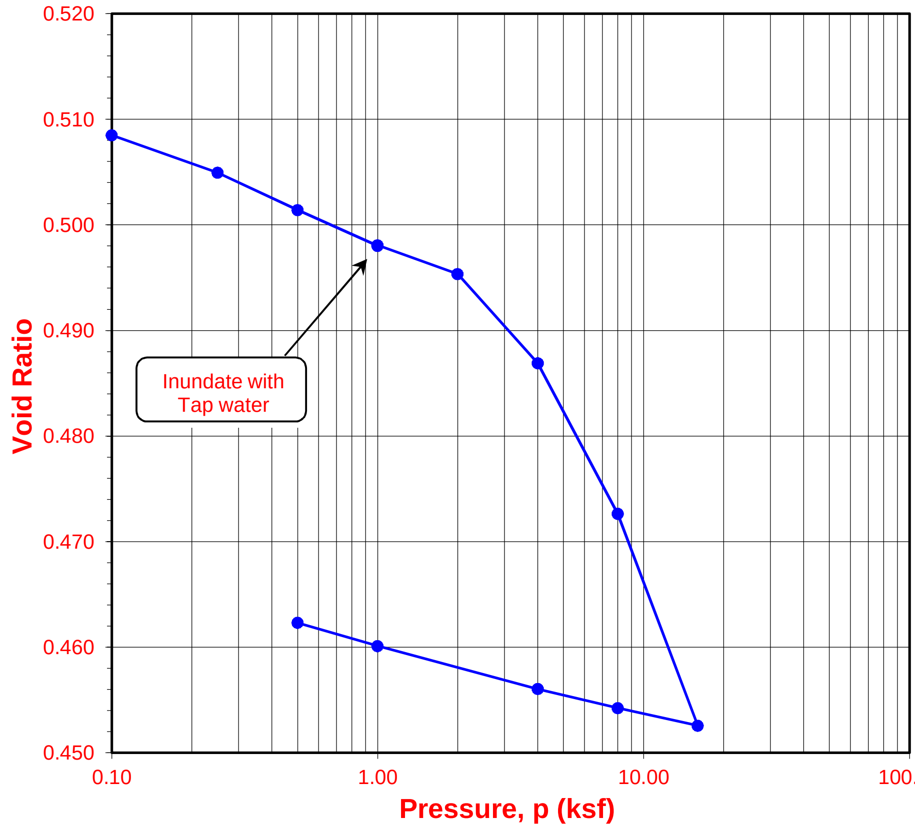
Project Number: 19035-01
Date: Apr-19

Great Scott - Lake Forest

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project Name:	Lake Forest	Tested By: G. Bathala	Date: 04/10/19
Project No.:	19035-01	Checked By: J. Ward	Date: 04/24/19
Boring No.:	HS-1	Depth (ft.): 7.5	
Sample No.:	R-3	Sample Type: Ring	
Soil Identification:	Dark olive brown clayey sand (SC)		

Sample Diameter (in.)	2.415
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	199.51
Weight of Ring (g)	45.62
Height after consol. (in.)	0.9688
Before Test	
Wt.Wet Sample+Cont. (g)	208.34
Wt.of Dry Sample+Cont. (g)	190.23
Weight of Container (g)	66.23
Initial Moisture Content (%)	14.6
Initial Dry Density (pcf)	111.7
Initial Saturation (%)	77
Initial Vertical Reading (in.)	0.3164
After Test	
Wt.of Wet Sample+Cont. (g)	269.38
Wt. of Dry Sample+Cont. (g)	250.41
Weight of Container (g)	71.40
Final Moisture Content (%)	14.22
Final Dry Density (pcf)	114.5
Final Saturation (%)	81
Final Vertical Reading (in.)	0.2809
Specific Gravity (assumed)	2.70
Water Density (pcf)	62.43

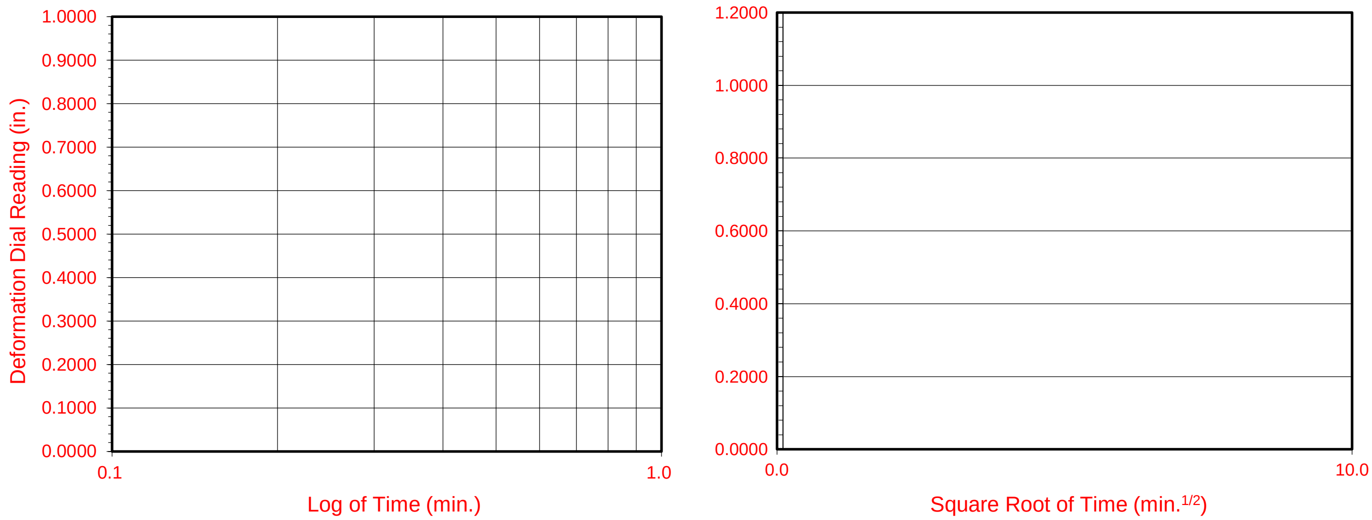


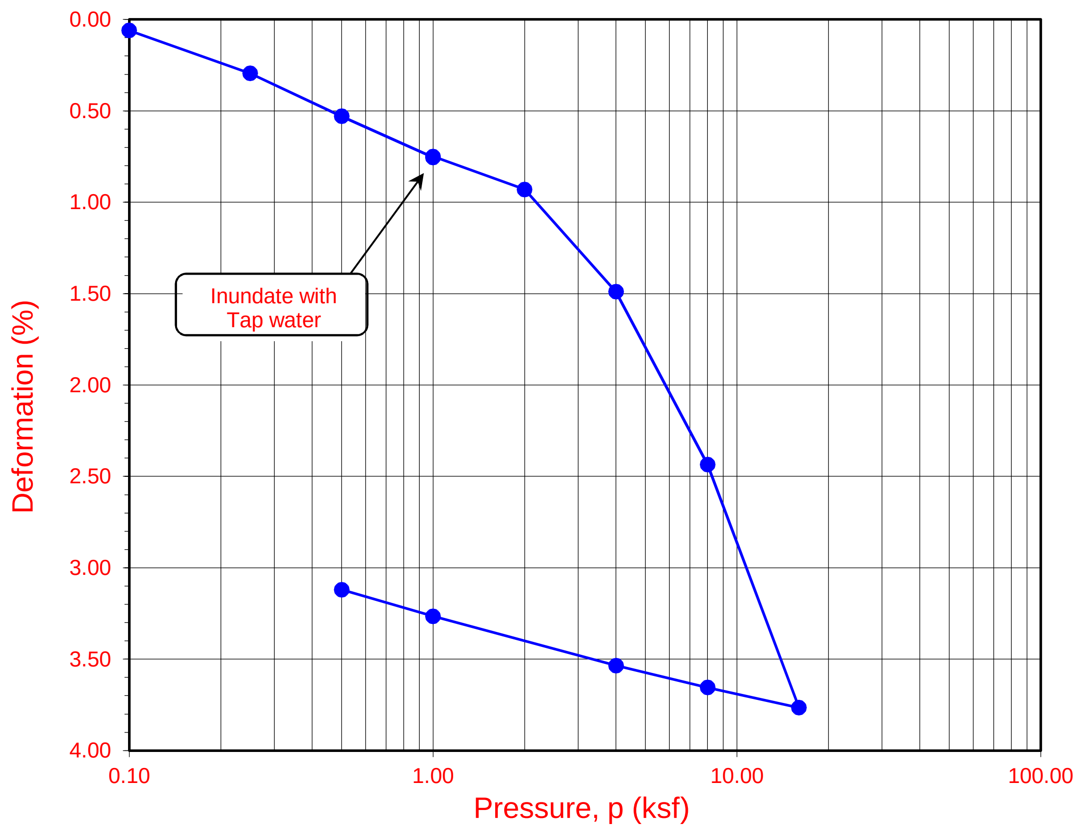
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.3158	0.9994	0.00	0.06	0.508	0.06
0.25	0.3128	0.9964	0.07	0.37	0.505	0.30
0.50	0.3098	0.9934	0.13	0.66	0.501	0.53
1.00	0.3068	0.9904	0.21	0.96	0.498	0.75
1.00	0.3068	0.9904	0.21	0.96	0.498	0.75
2.00	0.3038	0.9874	0.33	1.26	0.495	0.93
4.00	0.2969	0.9805	0.46	1.95	0.487	1.49
8.00	0.2857	0.9693	0.64	3.08	0.473	2.44
16.00	0.2702	0.9538	0.86	4.63	0.453	3.77
8.00	0.2721	0.9557	0.78	4.44	0.454	3.66
4.00	0.2743	0.9579	0.68	4.22	0.456	3.54
1.00	0.2788	0.9624	0.50	3.77	0.460	3.27
0.50	0.2809	0.9645	0.43	3.55	0.462	3.12

Time Readings

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)

Time Readings





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
HS-1	**R-3**	**7.5**	**14.6**	**14.2**	**111.7**	**114.5**	**0.509**	**0.462**	**77**	**81**

Soil Identification: Dark olive brown clayey sand (SC)

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project No.: 19035-01

Lake Forest

04-19

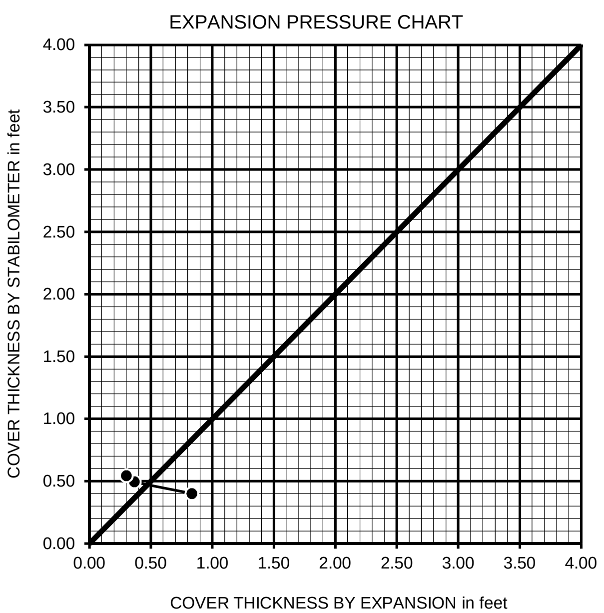
R-VALUE TEST RESULTS

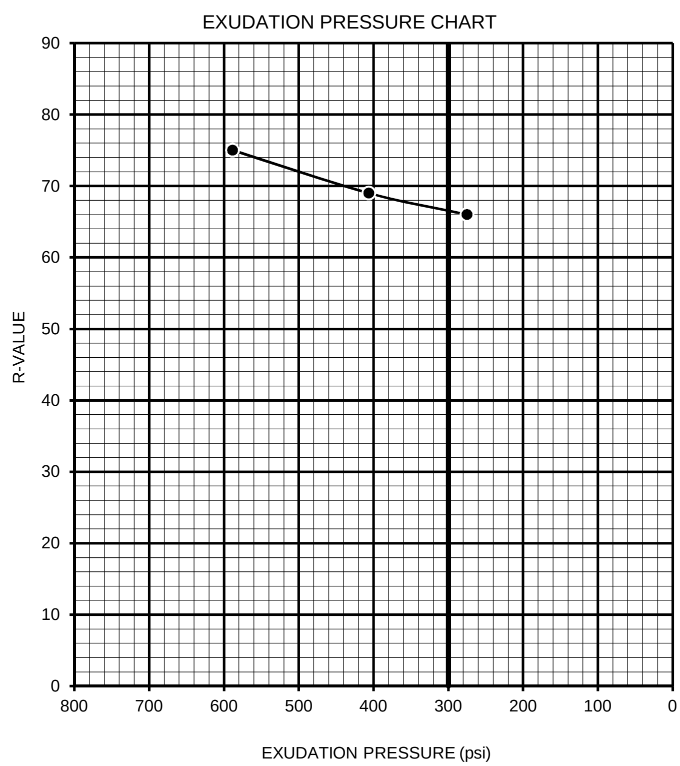
DOT CA Test 301

PROJECT NAME:	Lake Forest	PROJECT NUMBER:	19035-01
BORING NUMBER:	HS-2	DEPTH (FT.):	1-5
SAMPLE NUMBER:	B-1	TECHNICIAN:	S. Felter
SAMPLE DESCRIPTION:	Brown silty sand with Gravel (SM)	DATE COMPLETED:	4/16/2019

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	11.0	11.4	11.8
HEIGHT OF SAMPLE, Inches	2.49	2.50	2.59
DRY DENSITY, pcf	118.4	120.3	116.5
COMPACTOR PRESSURE, psi	350	300	250
EXUDATION PRESSURE, psi	588	406	275
EXPANSION, Inches x 10exp-4	25	11	9
STABILITY Ph 2,000 lbs (160 psi)	26	33	38
TURNS DISPLACEMENT	4.26	4.32	4.42
R-VALUE UNCORRECTED	75	69	64
R-VALUE CORRECTED	75	69	66

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.40	0.50	0.54
EXPANSION PRESSURE THICKNESS, ft.	0.83	0.37	0.30





R-VALUE BY EXPANSION:	70
R-VALUE BY EXUDATION:	66
EQUILIBRIUM R-VALUE:	66

Appendix D
Infiltration Test Data

Infiltration Test Data Sheet

LGC Geotechnical, Inc
131 Calle Iglesia Suite 200, San Clemente, CA 92672 tel. (949) 369-6141

Project Name: Great Scott - Lake Forest
Project Number: 19035-01
Date: 4/4/2019
Boring Number: I-1

Test hole dimensions (if circular)

Boring Depth (feet)*:	5
Boring Diameter (inches):	8
Pipe Diameter (inches):	2

*measured at time of test

Test pit dimensions (if rectangular)

Pit Depth (feet):	
Pit Length (feet):	
Pit Breadth (feet):	

Minimum test Head (D_o):
(What the sounder tape should read) Boring Depth - (5 x Boring Radius) 3.4 ft

(Shallow) The value on the sounder tape should be close to this value during testing for **DEEP** testing fill to 4 feet below top of hole

*Pre-Test (Sandy Soil Criteria)**

Trial No.	Start Time (24:HR)	Stop Time (24:HR)	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Greater Than or Equal to 0.5 feet (yes/no)
1	8:37	9:02	25.0	2.54	2.92	0.38	No
2	9:02	9:27	25.0	2.60	2.93	0.33	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight, and then obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25 inches

Main Test Data

Trial No.	Start Time (24:HR)	Stop Time (24:HR)	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (feet)	Calculated Infiltration Rate(in/hr)
1	9:28	9:58	30.0	2.50	2.88	0.38	0.6
2	9:59	10:29	30.0	2.47	2.88	0.41	0.7
3	10:30	11:00	30.0	2.53	2.91	0.38	0.6
4	11:01	11:31	30.0	2.53	2.93	0.4	0.7
5	11:32	12:02	30.0	2.54	2.95	0.41	0.7
6	12:03	12:33	30.0	2.49	2.91	0.42	0.7
7	12:34	13:04	30.0	2.58	3.00	0.42	0.7
8	13:05	13:35	30.0	2.52	2.93	0.41	0.7
9	13:36	14:06	30.0	2.53	2.95	0.42	0.7
10	14:07	14:37	30.0	2.48	2.89	0.41	0.7
11	14:38	15:08	30.0	2.45	2.90	0.45	0.7
12	15:09	15:39	30.0	2.53	2.98	0.45	0.7

Calculated Infiltration Rate (No factors of safety)	**0.7**
Factor of Safety	**2.0**
Calculated Infiltration Rate (With Factor of Safety)	**0.35**

Sketch:

Notes:

Based on Guidelines from: Orange County 05/19/2011
Spreadsheet Revised on: 10/26/2016

Appendix E
Liquefaction Analysis

LIQUEFACTION EVALUATION

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997
and *Evaluation of Settlments in Sand due to Earthquake Shaking*, Tokimatsu and Seed, 1987

Seismic Event		**Profile Constants**		**Depth to GWT**		**Project Name**	Great Scott M.V.
Moment Magnitude	6.9	Total Unit Weight (lb/ft^3)	120	During Investigation (ft)	15	**Project Number**	19035-01
Peak Ground Acceleration	0.53 g	Unit Weight of Water (lbs/ft	62.4	During Design Event (ft)	10	**Boring**	HS- 1

Determination of Cyclic Resitance Ratio

Sampling Data					During Investigation			Sampling Correction Factors											
		Blow Count		Thickness	Total Stress	Pore Pressure	Effective	Sampler	SPT	Overburden	Energy	Borehole	Rod Length	Sampler Type		Fines			
Depth (ft)	Depth (m)	SPT	Rings	(ft)	Stress (psf)	Pressure (psf)	Stress (psf)	Diameter	N_m	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Content	$(N_1)_{60cs}$	K_σ	$CRR_{7.5}$
2.5	0.8		12	3.75	420	0	420	0.62	7.44	1.70	1.25	1.00	0.75	1.00	11.86	5	11.9	1.000	0.128
5	1.5		6	2.5	720	0	720	0.62	3.72	1.70	1.25	1.00	0.75	1.00	5.94	25	10.9	1.000	0.118
7.5	2.3		11	3.75	1020	0	1020	0.62	6.82	1.43	1.25	1.00	0.75	1.00	9.15	25	14.5	1.000	0.157
10	3.0		5	2.5	1320	0	1320	0.62	3.10	1.26	1.25	1.00	0.75	1.00	3.66	37	9.4	1.000	0.102
15	4.6	5		5	1920	0	1920	1.00	5.00	1.04	1.25	1.00	0.85	1.10	6.09	50	12.3	1.000	0.133
20	6.1		23	5	2520	312	2208	0.62	14.26	0.97	1.25	1.00	0.95	1.00	16.47	6	16.6	0.986	0.176
25	7.6	23		5	3120	624	2496	1.00	23.00	0.91	1.25	1.00	0.95	1.10	27.48	16	31.7	0.965	SPT >30 NF
30	9.1		33	5	3720	936	2784	0.62	20.46	0.87	1.25	1.00	0.95	1.00	21.04	37	30.2	0.946	SPT >30 NF
35	10.7	38		5	4320	1248	3072	1.00	38.00	0.82	1.25	1.00	1.00	1.10	43.08	15	47.6	0.927	SPT >30 NF
40	12.2		100	5	4920	1560	3360	0.62	62.00	0.79	1.25	1.00	1.00	1.00	61.09	15	66.5	0.910	SPT >30 NF
45	13.7	100		2.5	5520	1872	3648	1.00	100.00	0.76	1.25	1.00	1.00	1.10	104.03	15	111.5	0.893	SPT >30 NF

Determination of Cyclic Stress Ratio

Sampling Data					During Design Event						
		Blow Count			Total Stress	Pore Pressure	Effective				
Depth (ft)	Depth (m)	SPT	Rings	Thickness	Stress (psf)	Pressure (psf)	Stress (psf)	r_d	CSR	MSF	FS
2.5	0.76		12	3.75	300	0	300	0.99615	0.343174	1.238	Above GWT
5	1.52		6	2.5	600	0	600	0.99024	0.341136	1.238	Above GWT
7.5	2.29		11	3.75	900	0	900	0.98456	0.339181	1.238	Above GWT
10	3.05		5	2.5	1200	0	1200	0.97914	0.337314	1.238	0.37
15	4.57	5		5	1800	312	1488	0.96856	0.403631	1.238	Bray-Clay
20	6.10		23	5	2400	624	1776	0.9569	0.445474	1.238	0.49
25	7.62	23		5	3000	936	2064	0.94183	0.471601	1.238	Corr. SPT>30
30	9.14		33	5	3600	1248	2352	0.92058	0.485417	1.238	Corr. SPT>30
35	10.67	38		5	4200	1560	2640	0.89062	0.488119	1.238	Corr. SPT>30
40	12.19		100	5	4800	1872	2928	0.85103	0.480625	1.238	Corr. SPT>30
45	13.72	100		2.5	5400	2184	3216	0.80363	0.464861	1.238	Corr. SPT>30

Appendix F
General Earthwork and Grading Specifications for Rough Grading

General Earthwork and Grading Specifications for Rough Grading

1.0 General

1.1 ***Intent:*** These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 ***The Geotechnical Consultant of Record:*** Prior to commencement of work, the owner shall employ a qualified Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to confirm that the attained level of compaction is being accomplished as specified. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 ***The Earthwork Contractor:*** The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the project plans and specifications. The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "equipment" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the

Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified. It is the contractor's sole responsibility to provide proper fill compaction.

2.0 Preparation of Areas to be Filled

2.1 ***Clearing and Grubbing:*** Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed. The contractor is responsible for all hazardous waste relating to his work. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Client should acquire the services of a qualified environmental assessor.

2.2 ***Processing:*** Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of oversize material and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 ***Overexcavation:*** In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 ***Benching:*** Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 ***Evaluation/Acceptance of Fill Areas:*** All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 ***General:*** Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 ***Oversize:*** Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 ***Import:*** If importing of fill material is required for grading, proposed import material shall meet the requirements of the geotechnical consultant. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 ***Fill Layers:*** Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 ***Fill Moisture Conditioning:*** Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557).

4.3 ***Compaction of Fill:*** After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 ***Compaction of Fill Slopes:*** In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.5 ***Compaction Testing:*** Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 ***Frequency of Compaction Testing:*** Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 ***Compaction Test Locations:*** The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

7.2 All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

7.3 The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

7.4 The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.5 Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

Lake Forest
County of Orange/Santa Ana Region
Priority Project
Water Quality Management Plan
(WQMP)

Project Name:

Great Scott Property

20865 Cañada Road

Lake Forest, CA, 92630

APN : 610-301-20, 610-301-07

Prepared for:

Great Scott Tree Service, Inc.

10761 Court Avenue

Stanton, CA 90680

(714) 826-1750

Prepared by:

Marc J. Haslinger, P.E.

Huitt-Zollars, Inc.

2603 Main Street, Suite 400

Irvine, CA, 92614

(949) 988-5815

Date Prepared: June 17th, 2021

Project Owner's Certification			
Planning Application No. (If applicable)	UP 03-18-5146	Grading Permit No.	
Tract/Parcel Map and Lot(s) No.	Parcel Map 86-133, Parcel A LLA 82-30	Building Permit No.	
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)			20865 Canada Road, Lake Forest, CA, 92630 APN: 610-301-20, 610-301-07

This Water Quality Management Plan (WQMP) has been prepared for **Great Scott Tree Service, Inc** by **Huitt-Zollars, Inc**.. The WQMP is intended to comply with the requirements of the County of Orange NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan , including the ongoing operation and maintenance of all best management practices (BMPs), and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner: Steve Guzowski			
Title	Chief Operating Officer		
Company	Great Scott Tree Service, Inc.		
Address	10761 Court Avenue, Stanton, CA, 90680		
Email	sguzowski@gstinc.com		
Telephone #	(714) 826-1750		
I understand my responsibility to implement the provisions of this WQMP including the ongoing operation and maintenance of the best management practices (BMPs) described herein.			
Owner Signature		Date	

Preparer (Engineer): Marc J. Haslinger			
Title	Vice President / Principal-in-Charge	PE Registration #	49158
Company	HUITT-ZOLLARS, INC.		
Address	2603 Main Street, Suite 400, Irvine, CA, 92614		
Email	mhaslinger@huitt-zollars.com		
Telephone #	(949) 988-5815		
I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.			
Preparer Signature		Date	
Place Stamp Here			

Contents

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Attachments

Section I Permit(s) and Water Quality Conditions of Approval or Issuance

Provide discretionary or grading/building permit information and water quality conditions of approval, or permit issuance, applied to the project. If conditions are unknown, please request applicable conditions from staff. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available on the OC Planning website (ocplanning.net).*

Project Infomation			
Permit/Application No. (If applicable)	UP 03-18-5146	Grading or Building Permit No. (If applicable)	
Address of Project Site (or Tract Map and Lot Number if no address) and APN	20865 Canada Road, Lake Forest, CA, 92630 apn: 610-301-20, 610-301-07		

Water Quality Conditions of Approval or Issuance	
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	This submittal is for preliminary review. Conditions of Approval will be provided with Final WQMP.

Conceptual WQMP	
Was a Conceptual Water Quality Management Plan previously approved for this project?	This submittal is for preliminary review.

Watershed-Based Plan Conditions	
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	This submittal is for preliminary review.

Section II Project Description

II.1 Project Description

Provide a detailed project description including:

- Project areas;
- Land uses;
- Land cover;
- Design elements;
- A general description not broken down by drainage management areas (DMAs).

Include attributes relevant to determining applicable source controls. *Refer to Section 2.2 in the Technical Guidance Document (TGD) for information that must be included in the project description.*

Description of Proposed Project				
Development Category (From Model WQMP, Table 7.11-2; or -3):	Parking lot of 5,000 square feet or more			
Project Area (ft²): 320,805	Number of Dwelling Units: 0		SIC Code: 2411,2421,5099, 7521	
Project Area	*Pervious		*Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	99,604.2 sq ft	74.0%	34,996.2 sq ft	26.0%
Post-Project Conditions	50,897.2 sq ft	42.8%	68,021.6 sq ft	57.2%
Drainage Patterns/Connections	In existing condition, the majority of the Project site generally drains north west and sheet flows into Serrano Creek. A small portion of the site is on the opposite side of Serrano Creek and sheets flows south, directly into the Creek. This area will be undisturbed throughout the existing and proposed conditions. The catch basins, area drains, and underground storm drain conduits in the proposed condition will be integrated into proposed storm drain infrastructure on site which will discharge into a detention basin onsite. The detention basin will then outlet into Serrano Creek. The existing drainage patterns and existing storm drain outlets to Serrano Creek were field verified on February 7, 2020. The Project intends to maintain existing grades and drainage patterns across the site, and does not result in increases of flow rate, volume, and time of concentration			

	for storm water leaving the Site. Proposed imperviousness will be increased to due to the addition of required parking stall and a concrete pad for landscape operations along with modeling of the proposed gravel areas as paved areas to be conservative (See Appendix D for Impervious Fraction calculations). *Note that the pre and post condition project areas do not match because in the post condition, grading along the southwest tract boundary and along Serrano Creek was adjusted to assist with draining. The difference in area between the pre and post drains off-site and is not accounted in the sizing of the three bio-swales and detention basin since it flows off-site.

Narrative Project Description: (Use as much space as necessary.)	The Project Site is located within the City of Lake Forest, CA, at the southwest corner of Dimension Drive and Linear Lane. It is bound by existing light industrial development on the north and south. Existing Serrano Creek runs east-west, through the length of the Project Site. In existing conditions, runoff from the Project Site sheet flows directly into Serrano Creek. The Project site is currently zoned for a combination of A-1 agricultural and M-1 light industrial uses There is one residential structure (with pool and landscaped yard and multiple livestock barn/pens and storage structures. The Project intends to maintain existing grades and drainage patterns across the site, and will not cause hydrologic conditions of concern (HCOC) to the downstream channel in accordance with the definition found in Section 5.3.1 of the Orange County Technical Guidance Document. The Time of Concentration requirement was met using values obtained from the AES rational method, and the Volume requirement was met using the Simple Method Runoff Coefficient for Volume-Based BMP Sizing (Eq. III.1) found in the TGD for project areas is less than 5 ac. The existing residential structure and one storage structure (historic barn) will remain in the proposed condition. Gravel will be laid over a large portion of the site to stabilize the existing native surface and allow for all-weather access and parking for Great Scott Tree Service vehicles. The existing residential structure will be converted into office space for Great Scott Tree Service, Inc., and a minimum parking lot constructed for office employee and guest parking. Three vegetated bioswale systems will be constructed to treat the Design Capture Volume (DCV). The proposed detention basin is designed to provide mitigation of the 100-year discharge. Please refer to the drainage report for 100-year storm event calculations. Majority of project site runoff for all storm events will be conveyed through storm drain pipe to a detention basin before reaching Serrano Creek which will result in the mitigation of post flows for all storm events. Stormwater runoff will first infiltrate into the gravel layer and flow towards inlet curbs that collects the water in a catch basin. Oil and hydrocarbon based pollutants will be filtered through a filter sock before being directed to the bioswale for further treatment. Water is then captured by an underdrain in the swale and then outletted to the detention basin. The basin will have an overflow to Serrano Creek to reduce peak flow from the site. The existing grade will allow runoff to naturally drain to the bioswale systems. Refer to Appendix A for a graphic of the treatment train in addition to the location of the bioswale systems. Refer to Appendix A for the Proposed Site Plan. See included Encumbrance Map (Appendix F) for Site Location.

II.2 Potential Stormwater Pollutants

Determine and list expected stormwater pollutants based on land uses and site activities. *Refer to Section 2.2.2 and Table 2.1 in the Technical Guidance Document (TGD) for guidance.*

Pollutants of Concern			
Pollutant	Check One for each: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E ☒	N ☐	Expected pollutant due to the proposed vehicle parking on site.
Nutrients	E ☒	N ☐	Depressed drought tolerant landscaping should be implemented to prevent suspended – solids/sediments, otherwise it is expected.
Heavy Metals	E ☒	N ☐	Expected pollutant due to proposed vehicle parking lot on-site and uncovered parking areas.
Pathogens (Bacteria/Virus)	E ☒	N ☐	Expected due to bacterial indicators in runoff.
Pesticides	E ☒	N ☐	Depressed drought tolerant landscaping should be implemented to prevent suspended – solids/sediments, otherwise it is expected.
Oil and Grease	E ☒	N ☐	Expected due to the proposed vehicle parking on site. Hydrocarbon filter socks should be implemented in the catch basins to capture oil and grease from vehicles.
Toxic Organic Compounds	E ☒	N ☐	Expected due to the proposed vehicle parking on site.
Trash and Debris	E ☒	N ☐	Expected due to the proposed vehicle parking on site.

II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the Technical Guidance Document (TGD) for North Orange County or Section 2.2.3.2 for South Orange County.*

☐ No – Show map

☒ Yes – Describe applicable hydrologic conditions of concern below. *Refer to Section 2.2.3 in the Technical Guidance Document (TGD).*

Existing Serrano Creek runs through the Project Site. Serrano Creek is identified as an unstable earth channel on OC TGD Figure XVI-3d. The referenced Figure also indicates that the Project Site is within a "Potential Area of Erosion, Habitat & Physical Structure Susceptibility.

Note that this project does not qualify as a Hydrologic Condition of Concern as outlined in the Orange County TGD as the time of concentration and runoff volume requirements have been met. A comparison for the 2-year storm event pre vs post development (unmitigated) was analyzed using Advance Engineering Software (AES) at compliance point (See Appendix D for the Existing Condition and Proposed Condition Unit Hydrographs calculations). The results from the analysis are summarized in the table below for peak flow rate and time of concentration.

Unmitigated Flows			
	Q_2 (cfs)	V_2 (ft^3)	T_{c2} (min)
Existing Condition (onsite only)	3.54	7,841	11.23
Proposed Condition (onsite only)	3.14	10,890	12.04
Pre Vs Post Unmitigated Flows- Delta (%)	-11.3%	+38.9%	+7.2%

The amount of impervious area is increased from the existing to the proposed condition. Using the AES, the peak discharge is not increased by more than 5% in the proposed condition. See attached AES calculations in Appendix D and Exhibits in Attachment A. The site meets the requirements of the MS4 Permit for HCOC mitigation. The implementation of the hydromodification BMPs are not required onsite.

II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics. *Refer to Section 2.2.4 in the Technical Guidance Document (TGD).*

The Project intends to maintain existing grades and drainage patterns across the site, and does not cause negative impacts to the flow rate, volume, and time of concentration for storm water leaving the Site. Three vegetated swales will be constructed along the perimeter of the project site to intercept the onsite stormwater runoff before it reaches Serrano Creek. The underdrains of the vegetated swale will be connected to a proposed stormdrain system that conveys on site runoff underneath the project site to a detention basin in the southwest corner of the site. This detention basin will have an underdrain that will outlet to Serrano Creek. A detention basin is proposed due to erosion issues along Serrano Creek, and future developments have been requested to reduce flows by a minimum of 38%. The detention basin was designed using the 100-year storm event.

II.5 Property Ownership/Management

Describe property ownership/management. *Refer to Section 2.2.5 in the Technical Guidance Document (TGD).*

Project Site will be owned and maintained by Great Scott Tree Service, Inc.

Section III Site Description

III.1 Physical Setting

Fill out table with relevant information. *Refer to Section 2.3.1 in the Technical Guidance Document (TGD).*

Name of Planned Community/Planning Area (if applicable)	N/A	
Location/Address	20865 Cañada Road	
	Lake Forest, CA, 92630	
General Plan Land Use Designation	Regional Park/Open Space	
Zoning	M-1 (Light Industrial) with Planned Development (PD), A-1 (General Agriculture	
Acreage of Project Site	7.36 acres	
Predominant Soil Type	Type D (per NRCS Soil Survey)	

III.2 Site Characteristics

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.2 in the Technical Guidance Document (TGD).*

Site Characteristics	
Precipitation Zone	0.9 (per OC TGD Figure XVI-1)
Topography	Site generally slopes north west at 3% to 6%

Drainage Patterns/Connections	Site generally slopes north west, drains via surface sheet flow directly to Serrano Creek. An underground storm conduit is proposed from the bio-swales to the proposed detention basin.
Soil Type, Geology, and Infiltration Properties	Soil Type D (Per NRCS Soil Survey), Serrano Creek runs through the Site and is not susceptible to erosion, soil is primarily Sandy Loam and Sorrento Loam along the top and upper banks for Serrano Creek, with Riverwash (sandy gravelly alluvium) located along the bottom of the Creek.
Hydrogeologic (Groundwater) Conditions	Per the OC TGM North Orange County Mapped Shallow Groundwater Map the proposed development is not located within a region that encounters groundwater depth equal to or less than 5 feet and 5 feet to 10 feet.
Geotechnical Conditions (relevant to infiltration)	The geotechnical report advises against intentional infiltration of stormwater due to low infiltration rate, shallow groundwater, and high liquefaction potential.
Off-Site Drainage	N/A. Site does not receive off-site drainage. The assumption was field verified on February 7, 2020.
Utility and Infrastructure Information	Project site is currently serviced by wet and dry utilities.

III.3 Watershed Description

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.3 in the Technical Guidance Document (TGD).*

Receiving Waters	Serrano Creek, San Diego Creek Reach 2, San Diego Creek Reach 1, Newport Bay
303(d) Listed Impairments	Bacteria Indicators/Pathogens, Metals, Nutrients, Toxicity, Turbidity, Other Organics
Applicable TMDLs	Bacteria Indicators/Pathogens, Metals, Nutrients, Pesticides, Turbidity/Siltation
Pollutants of Concern for the Project	Suspended Solis/Sediments, Nutrients, Heavy Metals, Pathogens (Bacteria/Virus), Pesticides, Oil & Grease, Toxic Organic Compounds, Trash & Debris
Environmentally Sensitive and Special Biological Significant Areas	N/A

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Describe project performance criteria. Several steps must be followed in order to determine what performance criteria will apply to a project. These steps include:

- If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used and the project can evaluate participation in the approved regional or sub-regional opportunities. (Please ask your assigned planner or plan checker regarding whether your project is part of an approved WIHMP or equivalent.)
- Determine applicable hydromodification control performance criteria. *Refer to Section 7.II-2.4.2.2 of the Model WQMP.*
- Determine applicable LID performance criteria. *Refer to Section 7.II-2.4.3 of the Model WQMP.*
- Determine applicable treatment control BMP performance criteria. *Refer to Section 7.II-*3.2.2 *of the Model WQMP.*
- Calculate the LID design storm capture volume for the project. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	N/A	

Project Performance Criteria	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	Project does not cause negative impacts in runoff volume, changes in time of concentration, increase for post development downstream erosion, or adverse downstream impacts. The Project intends to revise drainage patterns across the site to stay onsite, will concentrate flow to bioswales, underdrains, and a detention basin, and will include applicable water quality features. Additionally, the Project proposed to lay gravel over a large portion of the property. From a conservative standpoint The Project will assume all gravel areas to be paved for modeling purposes.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	• Priority Projects must infiltrate, harvest and use, evapotranspire, or biotreat/biofilter, the 85th percentile, 24-hour storm event (Design Capture Volume). • A properly designed biotreatment system may only be considered if infiltration, harvest and use, and evapotranspiration (ET) cannot be feasibly implemented for the full design capture volume. In this case, infiltration, harvest and use, and ET practices must be implemented to the greatest extent feasible and biotreatment may be provided for the remaining design capture volume. A diversity of controls will be provided, if feasible, to achieve the greatest feasible retention of the Design Capture Volume, then if necessary, biotreatment of the remaining design capture volume. Equivalent performance criteria have been synthesized from permit requirements with consideration of the MEP standard and analysis of local precipitation and ET patterns. The following performance criteria result in capture and retention and/or biotreatment of 80 percent of average annual stormwater runoff volume. The performance criteria for LID are stated as follows: • LID BMPs must be designed to retain, on-site, (infiltrate, harvest and use, or evapotranspire) stormwater runoff up to 80 percent average annual capture efficiency • LID BMPs must be designed to: o Retain, on-site, (infiltrate, harvest and use, or evapotranspire) stormwater runoff as feasible up to the Design Capture Volume, and o Recover (i.e., draw down) the storage volume as soon as possible after a storm event (see criteria for maximizing drawdown rate in the TGD Appendix XI), and, if necessary o Biotreat, on-site, additional runoff, as feasible, up to 80 percent average annual capture efficiency (cumulative, retention plus biotreatment), and, if necessary o NOC Permit Area only – retain or biotreat, in a regional facility, the remaining runoff up to 80 percent average annual capture efficiency (cumulative, retention plus biotreatment, on-site plus off-site), and, if necessary

	o Fulfill alternative compliance obligations for runoff volume not retained or biotreated up to 80 percent average annual capture efficiency using treatment controls or other alternative approaches as described in Section 7.II-3.
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	Retain onsite Stormwater runoff, as feasible, up to the Design Capture Volume; Recover the storage volume as soon as possible after a storm event; Biotreat onsite additional runoff, as feasible, up to 80 percent average annual capture efficeiency;
Calculate LID design storm capture volume for Project.	DCV = C × d × A × 43560 sf/ac × 1/12 in/ft Q=CiA Where: DCV = design storm capture volume, cu-ft C = runoff coefficient = (0.75 × imp + 0.15) Imp = impervious fraction of drainage area (ranges from 0 to 1) d = storm depth (inches) A = tributary area (acres) Q_{Design} = Design Flow Rate

	DMA		
	A	B	C
Design Capture Storm Depth	0.9	0.9	0.9
Drainage Area (SF)	19,685	70,132	29,185
Impervious Area (SF)	11,533	50,260	6,172
Pervious Area (SF)	8,152	19,871	23,014
% Impervious	0.59	0.72	0.21
Eff. Ret. Depth of HSC (in)	0.00	0.00	0.00
Design Infiltration Rate (in/hr)	0.00	0.00	0.00
Design Capture Volume (CF)	**870**	**3,616**	**675**
i (design intensity) (inches/hr)	0.26	0.26	0.26
Design Treatment Flow Rate (CFS)	**0.07**	**0.29**	**0.05**

IV.2. Site Design and Drainage

Describe site design and drainage including

- A narrative of site design practices utilized or rationale for not using practices;
- A narrative of how site is designed to allow BMPs to be incorporated to the MEP
- A table of DMA characteristics and list of LID BMPs proposed in each DMA.
- Reference to the WQMP "BMP Exhibit."
- Calculation of Design Capture Volume (DCV) for each drainage area.
- A listing of GIS coordinates for LID and Treatment Control BMPs.

Refer to Section 2.4.2 in the Technical Guidance Document (TGD).

The Project intends to revise existing grades and drainage patterns across the site to remain on site until routed through bio-swales and a detention basin, and does not cause negative impacts to the flow rate, volume, and time of concentration for storm water leaving the Site. The catch basins, area drains, and underground storm drain conduits in the proposed condition will be integrated into a minimal amount of new storm drain infrastructure on site.

Gravel will be laid over a majority of the site to stabilize the existing native soil and allow for all weather access and vehicle parking. Water quality treatment will be provided via proposed vegetated swales located at the edge of the gravel. The swales will capture and bio-treat runoff prior to conveyance to a detention basin through a storm drain system. The proposed detention basin will have an underdrain system that will discharge to Serrano Creek with reduced flows. The gravel and swales are intended to maintain dispersed sheet flow across the site and into the bio-swales.

IV.3 LID BMP Selection and Project Conformance Analysis

Each sub-section below documents that the proposed design features conform to the applicable project performance criteria via check boxes, tables, calculations, narratives, and/or references to worksheets. *Refer to Section 2.4.2.3 in the Technical Guidance Document (TGD) for selecting LID BMPs and Section 2.4.3 in the Technical Guidance Document (TGD) for conducting conformance analysis with project performance criteria.*

IV.3.1 Hydrologic Source Controls (HSCs)

If required HSCs are included, fill out applicable check box forms. If the retention criteria are otherwise met with other LID BMPs, include a statement indicating HSCs not required.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☒
Street trees (canopy interception)	☒
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☒
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

IV.3.2 Infiltration BMPs

Identify infiltration BMPs to be used in project. If design volume cannot be met, state why.

Infiltration BMPs are not applicable to the site.

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration BMPs. If not, document how much can be met with infiltration and document why it is not feasible to meet the full volume with infiltration BMPs.

Onsite infiltration testing indicates an observed infiltration rate of 0.7 in/hr and a design infiltration rate of 0.35 in/hr. This is higher than the minimum 0.3 in/hr required for infiltration-based BMPs which means that the proposed vegetated swale is feasible although not recommended by the geotechnical report due to other factors including shallow groundwater and liquefaction potential.

Using the methods found in the Orange County Technical Guidance Document, a more conservative safety factor of approximately 3.4 would be calculated resulting in a measured infiltration rate under 0.3 in/hr. However, the site can benefit from incidental infiltration in the gravel area and vegetated swales, thus making the bioswales feasible.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, describe any evapotranspiration and/or rainwater harvesting BMPs included.

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Storm Capture Volume can be met with evapotranspiration and/or rainwater harvesting BMPs in combination with infiltration BMPs. If not, document below how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with these BMP categories.

Evapotranspiration, Rainwater Harvesting BMPs not applicable.

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs included. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☐
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☒
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☐
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Storm Capture Volume can be met with infiltration, evapotranspiration, rainwater harvesting and/or biotreatment BMPs. If not, document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with these BMP categories.

Three (3) bioswales (Bio-2) will be employed for treatment of the required runoff flowrates.

	DMA		
	A	**B**	**C**
Design Capture Storm Depth	0.9	0.9	0.9
Drainage Area (SF)	19,685	70,132	29,185
Impervious Area (SF)	11,533	50,260	6,172
Pervious Area (SF)	8,152	19,871	23,014
% Impervious	0.59	0.72	0.21
Eff. Ret. Depth of HSC (in)	0.00	0.00	0.00
Design Infiltration Rate (in/hr)	0.00	0.00	0.00
Design Capture Volume (CF)	**870**	**3,616**	**675**
i (design intensity) (inches/hr)	0.26	0.26	0.26
Design Treatment Flow Rate (CFS)	**0.07**	**0.29**	**0.05**

Vegetated Swale (per OC TGD BIO-2)			
	DMA		
	A	**B**	**C**
swale slope (ft/ft)	0.0400	0.0100	0.0100
bottom width, calculated (ft)	0.30	2.46	0.46
bottom width used (2 ft min) (ft)	3.00	5.00	5.00
y, depth (ft)	0.08	0.22	0.08
Vwq	0.27	0.25	0.13
Required Length, ft	160	148	80
Length Provided, ft	177	200	140

IV.3.5 Hydromodification Control BMPs

Describe hydromodification control BMPs. *See Section 5 of the Technical Guidance Document (TGD).* Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval (if applicable).

Hydromodification Control BMPs	
BMP Name	**BMP Description**
N/A	

IV.3.6 Regional/Sub-Regional LID BMPs

Describe regional/sub-regional LID BMPs in which the project will participate. *Refer to Section 7.II-2.4.3.2 of the Model WQMP.*

Regional/Sub-Regional LID BMPs
N/A

IV.3.7 Treatment Control BMPs

Treatment control BMPs can only be considered if the project conformance analysis indicates that it is not feasible to retain the full design capture volume with LID BMPs. Describe treatment control BMPs including sections for selection, sizing, and infeasibility, as applicable.

Treatment Control BMPs	
BMP Name	**BMP Description**
Grated Inlet	Acts as a trash rack for larger pollutants
Hydrocarbon filter socks	Filters oil-based pollutants

IV.3.8 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used.

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	
N6	Local Industrial Permit Compliance	☒	☐	
N7	Spill Contingency Plan	☒	☐	
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks
N9	Hazardous Materials Disclosure Compliance	☒	☐	
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	No load docks
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	Not a retail gasoline outlet

IV.3.9 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if structural source controls were not used.

Structural Source Control BMPs

Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☒	☐	
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☒	☐	
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☒	☐	
S6	Dock areas	☐	☒	No dock areas proposed
S7	Maintenance bays	☐	☒	No maintenance bays
S8	Vehicle wash areas	☐	☒	No vehicle wash area
S9	Outdoor processing areas	☒	☐	
S10	Equipment wash areas	☐	☒	No equipment wash area
S11	Fueling areas	☐	☒	No fueling area
S12	Hillside landscaping	☐	☒	No hillside landscaping
S13	Wash water control for food preparation areas	☐	☒	No wash water control for food preparation area
S14	Community car wash racks	☐	☒	No community car wash racks

IV.4 Alternative Compliance Plan (If Applicable)

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the WQMP.*

IV.4.1 Water Quality Credits

Determine if water quality credits are applicable for the project. *Refer to Section 3.1 of the Model WQMP for description of credits and Appendix VI of the Technical Guidance Document (TGD) for calculation methods for applying water quality credits.*

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td colspan="5">Project Types that Qualify for Water Quality Credits (Select all that apply): None</td></tr>
<tr><td>☐Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="2">☐Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.</td><td colspan="2">☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).</td></tr>
<tr><td colspan="2">☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).</td><td colspan="2">☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned</td><td>☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).</td></tr>
<tr><td>☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.</td><td>☐ Developments in a city center area.</td><td>☐ Developments in historic districts or historic preservation areas.</td><td>☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.</td><td>☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
</table>

Calculation of Water Quality Credits (if applicable)	N/A

IV.4.2 Alternative Compliance Plan Information

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the Model WQMP.*

N/A

Section V Inspection/Maintenance Responsibility for BMPs

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the funding mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.*

BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**
Will be provided in Final WQMP			

Section VI BMP Exhibit (Site Plan)

VI.1 BMP Exhibit (Site Plan)

Include a BMP Exhibit (Site Plan), at a size no less than 24" by 36," which includes the following minimum information:

- Insert in the title block (lower right hand corner) of BMP Exhibit: the WQMP Number (assigned by staff) and the grading/building or Planning Application permit numbers
- Project location (address, tract/lot number(s), etc.)
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Delineate the area being treated by each structural BMP
- GIS coordinates for LID and Treatment Control BMPs
- Drainage connections
- BMP details
- Preparer name and stamp

Please do not include any areas outside of the project area or any information not related to drainage or water quality. The approved BMP Exhibit (Site Plan) shall be submitted as a plan sheet on all grading and building plan sets submitted for plan check review and approval. The BMP Exhibit shall be at the same size as the rest of the plan sheets in the submittal and shall have an approval stamp and signature prior to plan check submittal.

VI.2 Submittal and Recordation of Water Quality Management Plan

Following approval of the Final Project-Specific WQMP, three copies of the approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be submitted. In addition, these documents shall be submitted in a PDF format.

Each approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be recorded in the Orange County Clerk-Recorder's Office, prior to close-out of grading and/or building permit. Educational Materials are not required to be included.

Section VII Educational Materials

Refer to the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. Please only attach the educational materials specifically applicable to this project. Other materials specific to the project may be included as well and must be attached.

Education Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☐	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☒
Household Tips	☐	**Other Material**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	☐		
Recycle at Your Local Used Oil Collection Center (North County)	☐		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☐		☐
Sewer Spill	☐		☐
Tips for the Home Improvement Projects	☐		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☐		☐
Tips for Pet Care	☐		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐		☐
Tips for Projects Using Paint	☐		☐

Appendix A

Vicinity Map & Exhibits

PREPARED BY:

HUITT-ZOLLARS
Huitt-Zollars, Inc. Irvine
2603 Main Street, Suite 400
Irvine, California 92614
Phone (949) 988-5815 Fax (949) 988-5820

Marc Haslinger, P.E. DATE
R.C.E. No.

REGISTERED PROFESSIONAL ENGINEER
MARC J. HASLINGER
No. 49158
Expiration 09-30-20
CIVIL
STATE OF CALIFORNIA

REVISIONS			
MARK	DATE	DESCRIPTION	BY

REVIEWED BY: DATE
DATE

20865 Canada Road Lake Forest
EXISTING HYDROLOGY MAP

SCALE: **AS NOTED**
DRAWN BY: HZ
CHECKED BY: MH
SHEET No. 1 OF 1
DRAWING NUMBER

Q:\R308444.01 – 20865 Canada Road Lake Forest Engr\10 CADD & BIM\10.13 Civil\Hydro\Existing Drainage Exhibit.dwg

PREPARED BY:

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Marc Haslinger, P.E. DATE
R.C.E. No. ____

REGISTERED PROFESSIONAL ENGINEER
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No. 49158
Expiration
09-30-20
CIVIL
STATE OF CALIFORNIA

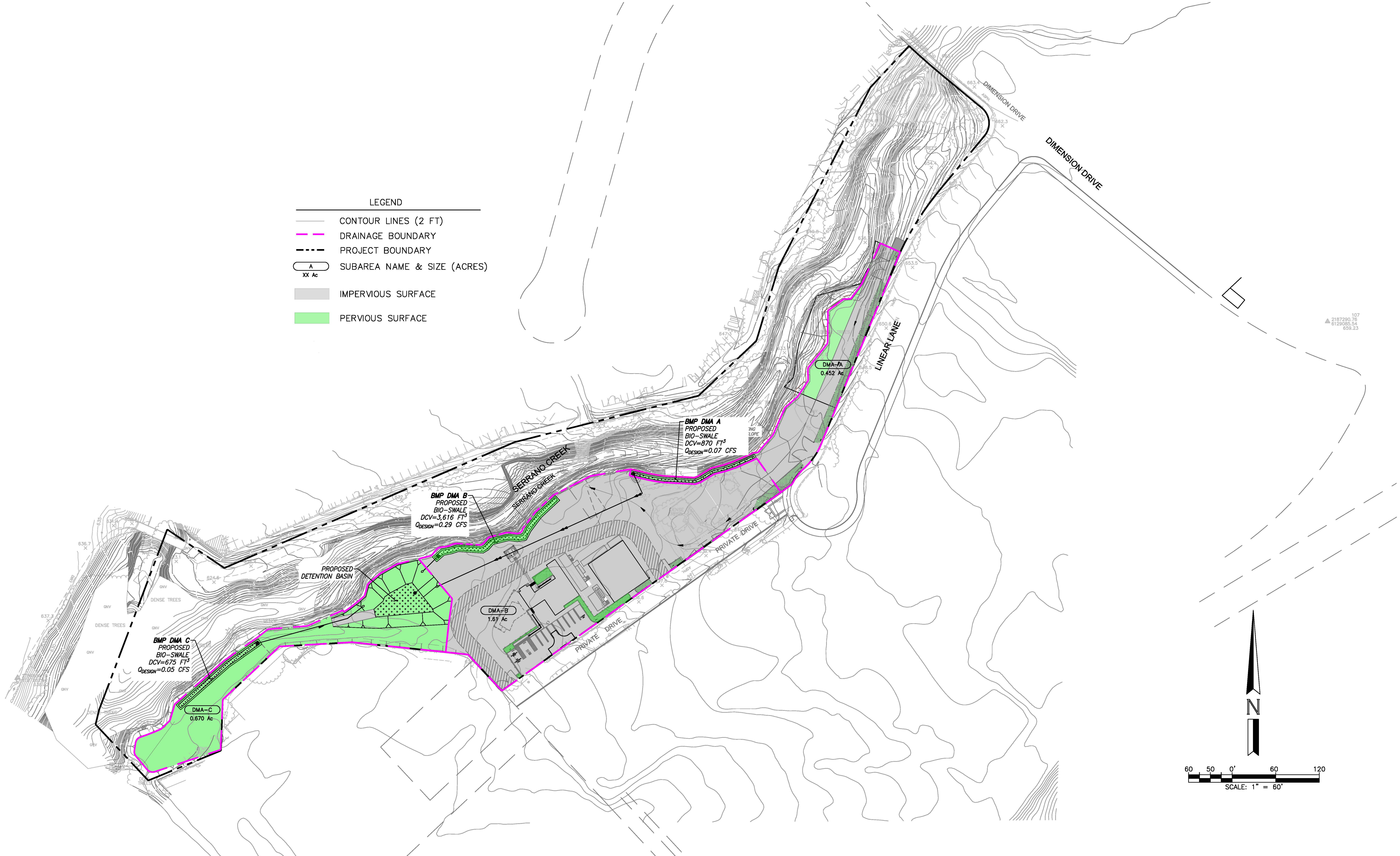
REVISIONS			
MARK	DATE	DESCRIPTION	BY

REVIEWED BY:
DATE
DATE

20865 Canada Road Lake Forest
PROPOSED HYDROLOGY MAP

SCALE: **AS NOTED**
SHEET No. 1 OF 1
DRAWN BY: HZ
DRAWING NUMBER
CHECKED BY: MH

Q:\R308444.01 – 20865 Canada Road Lake Forest Engr\10 CADD & BIM\10.13 Civil\Hydro\Existing Drainage Exhibit.dwg



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No. 49158
Expiration 09-30-20
CIVIL
STATE OF CALIFORNIA

REVISIONS

MARK	DATE	DESCRIPTION	BY

REVIEWED BY: DATE

DATE

20865 Canada Road Lake Forest

PRELIMINARY WQMP EXHIBIT

SCALE: **AS NOTED**

DRAWN BY: HZ

CHECKED BY: MH

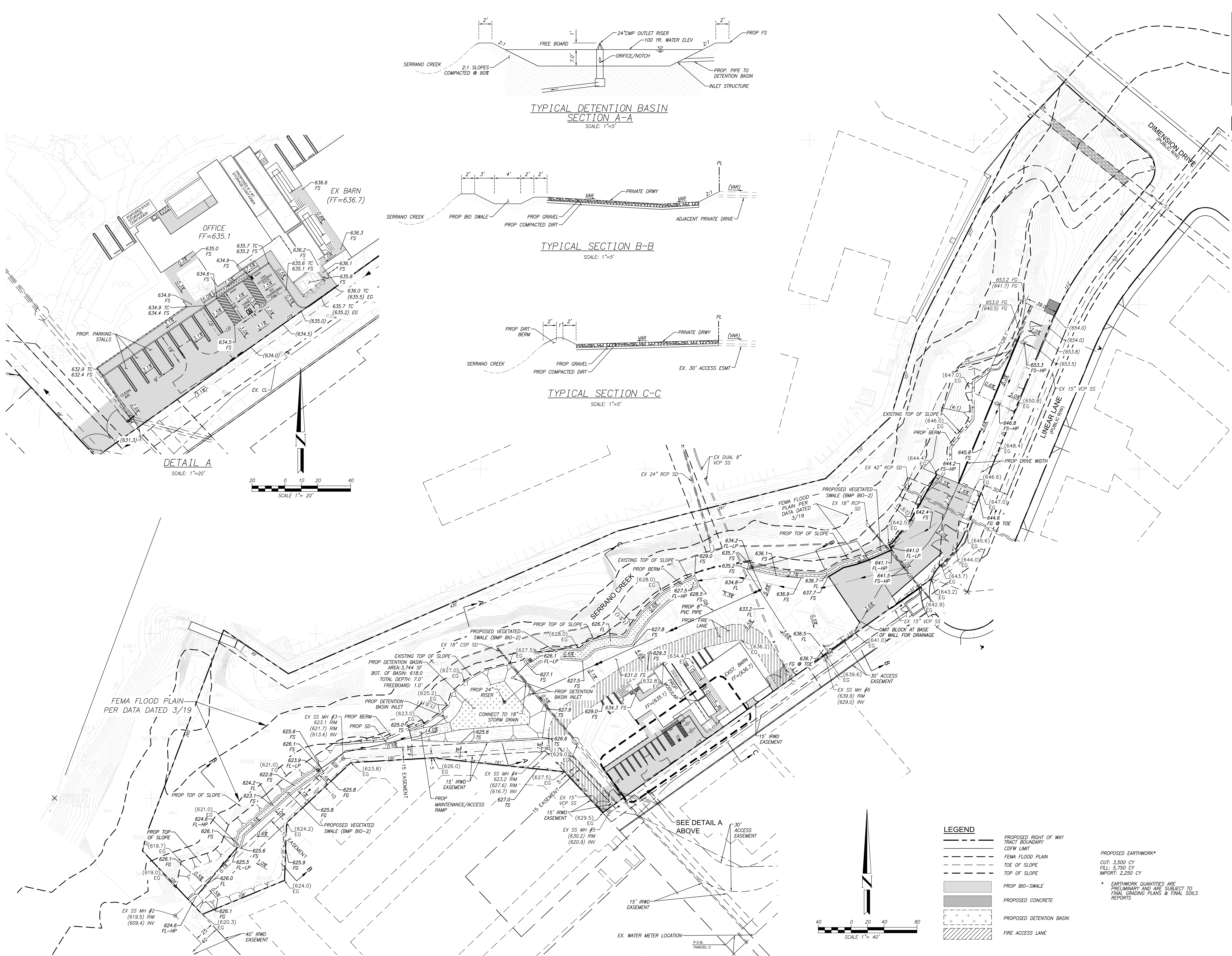
SHEET No. 1 OF 1

DRAWING NUMBER

Q:\R308444.01 – 20865 Canada Road Lake Forest Engr\10 CADD & BIM\10.13 Civil\Hydro\Existing Drainage Exhibit.dwg

Appendix B

Site Plan



HERDMAN
ARCHITECTURE + DESIGN

16201 SCIENTIFIC WAY
IRVINE, CA 92618
TEL. [illegible]14.389 .2800
www.Herdman-AD.com

PROJECT

GREAT SCOTT TREE SERVICE

2065 CANADA ROAD
LAKE FOREST, CA

CLIENT

GREAT SCOTT TREE SERVICE INC.

10[illegible]61 COURT AVENUE
STANTON, CA 90680

PROJECT TEAM

GENERAL CONTRACTOR
T.B.D.

CIVIL
HUITT - ZOLLARS INC.

PROJECT MANAGEMENT
E P D SOLUTIONS INC.

DRAWING INFO

ID	DATE	DESCRIPTION
		PLAN CHECK No. 000

DRAWN [illegible]S
H-A&D JOB A19-2049
ISSUE -
DRAWING SCALE AS SHOWN

PRELIMINARY GRADING AND DRAINAGE PLAN GREAT SCOTT PROPERTY

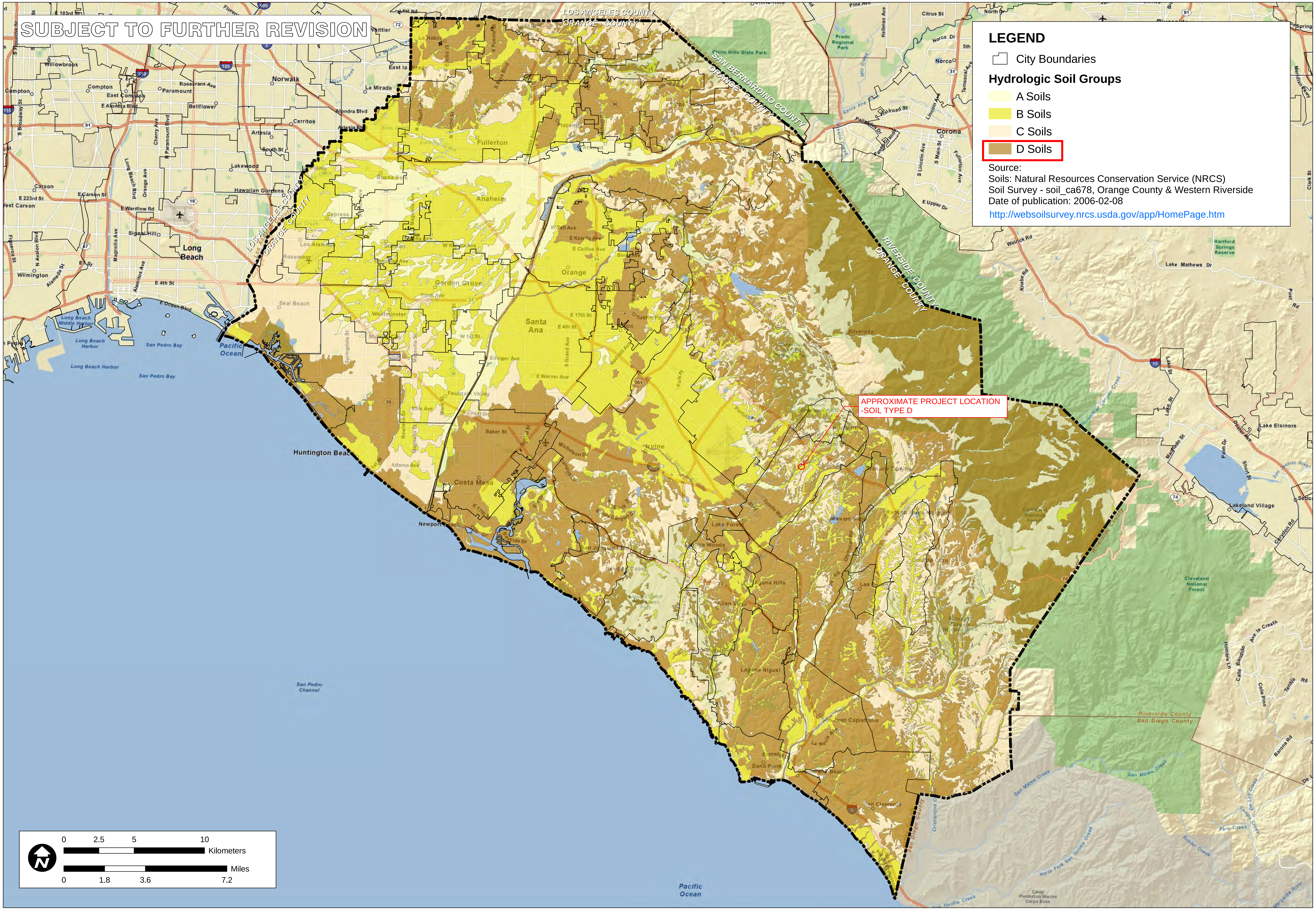
C1.0

Q:\R308444.01 – 20865 Canada Road Lake Forest Engr\10 CADD & BIM\10.13 Civil\Production\Preliminary Site Plan\Preliminary Grading Plan.dwg Jun 30 2021 8:36am

06/30/21

Appendix C

Soils Information



TITLE
NRCS HYDROLOGIC SOILS GROUPS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE 1" = 1.8 miles
DESIGNED TH
DRAWING TH
CHECKED BMP
DATE 02/09/11
JOB NO. 9526-E

PACE Advanced Water Engineering

FIGURE
XVI-2a

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2a_HydroSoils_20110215.mxd

LGC Geotechnical, Inc.

May 28, 2019

Project No. 19035-01

Mr. Jeremy Krout
EPD Solutions, Inc.
2030 Main Street, Suite 1200
Irvine, CA 92614

Subject: ***Preliminary Geotechnical Evaluation and Design Recommendations for Proposed Great Scott Tree Service Development, 20865 Canada Road, Lake Forest, California***

In accordance with your request and authorization, LGC Geotechnical, Inc. has performed a preliminary geotechnical evaluation for the proposed Great Scott Tree Service Development located at 20865 Canada Road in the City of Lake Forest, California. The purpose of our study was to evaluate the existing onsite geotechnical conditions and to provide preliminary geotechnical recommendations relative to the proposed development.

Should you have any questions regarding this report, please do not hesitate to contact our office. We appreciate this opportunity to be of service.

Respectfully Submitted,

LGC Geotechnical, Inc.

REGISTERED PROFESSIONAL ENGINEER RYAN L. DOUGLAS No. 84840 CIVIL STATE OF CALIFORNIA

Ryan Douglas, RCE 84840
Project Engineer

Katie Maes, CEG 2216
Project Geologist

PROFESSIONAL GEOLOGIST KATHERIN M. MAES No. 2216 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

RLD/KTM/ala

Distribution: (4) Addressee (3 wet-signed copies and 1 electronic copy)
(4) Great Scott Tree Service, Inc. (electronic copy)
Attn: Mr. Steve Guzowski

TABLE OF CONTENTS

Section ***Page***

LIST OF ILLUSTRATIONS, TABLES, AND APPENDICES

Figures

Tables

Appendices

1.0 INTRODUCTION

1.1 Purpose and Scope of Services

This report presents the results of our preliminary geotechnical evaluation for the proposed development located at 20865 Canada Road in the City of Lake Forest, California. Refer to the Site Location Map (Figure 1).

The purpose of our study was to provide a preliminary geotechnical evaluation relative to the proposed development. As part of our scope of work, we have: 1) reviewed available geotechnical background information including in-house regional geologic maps and published geotechnical literature pertinent to the site (Appendix A); 2) performed a limited subsurface geotechnical evaluation of the site consisting of the excavation of three small-diameter borings ranging in depth from approximately 5 to 50 feet below existing ground surface; 3) performed one field infiltration test; 4) performed laboratory testing of select soil samples obtained during our subsurface evaluation; and 5) prepared this geotechnical summary report presenting our preliminary findings, conclusions and recommendations for the development of the proposed project.

1.2 Existing Conditions

The approximately 6.4-acre irregular-shaped site is bound to the north by commercial/industrial developments, to the east by Dimension Drive, to the south by Linear Lane and two existing industrial buildings and to the west by Serrano Creek. Serrano Creek meanders from east to west through the site and is primarily located in the northern region of the site. The site's current use is primarily a residence/farm and vehicular storage yard. The central and western portion of the site contain a residential structure, barn, livestock stables, a horse corral/arena, unpaved and paved roads and miscellaneous debris. The eastern portion of the site contains a manmade lot currently used for vehicular storage. Entry to the site is from either Linear Lane or Canada Road. Vegetation across the site consists of grass, brush, bushes and areas of dense tree growth.

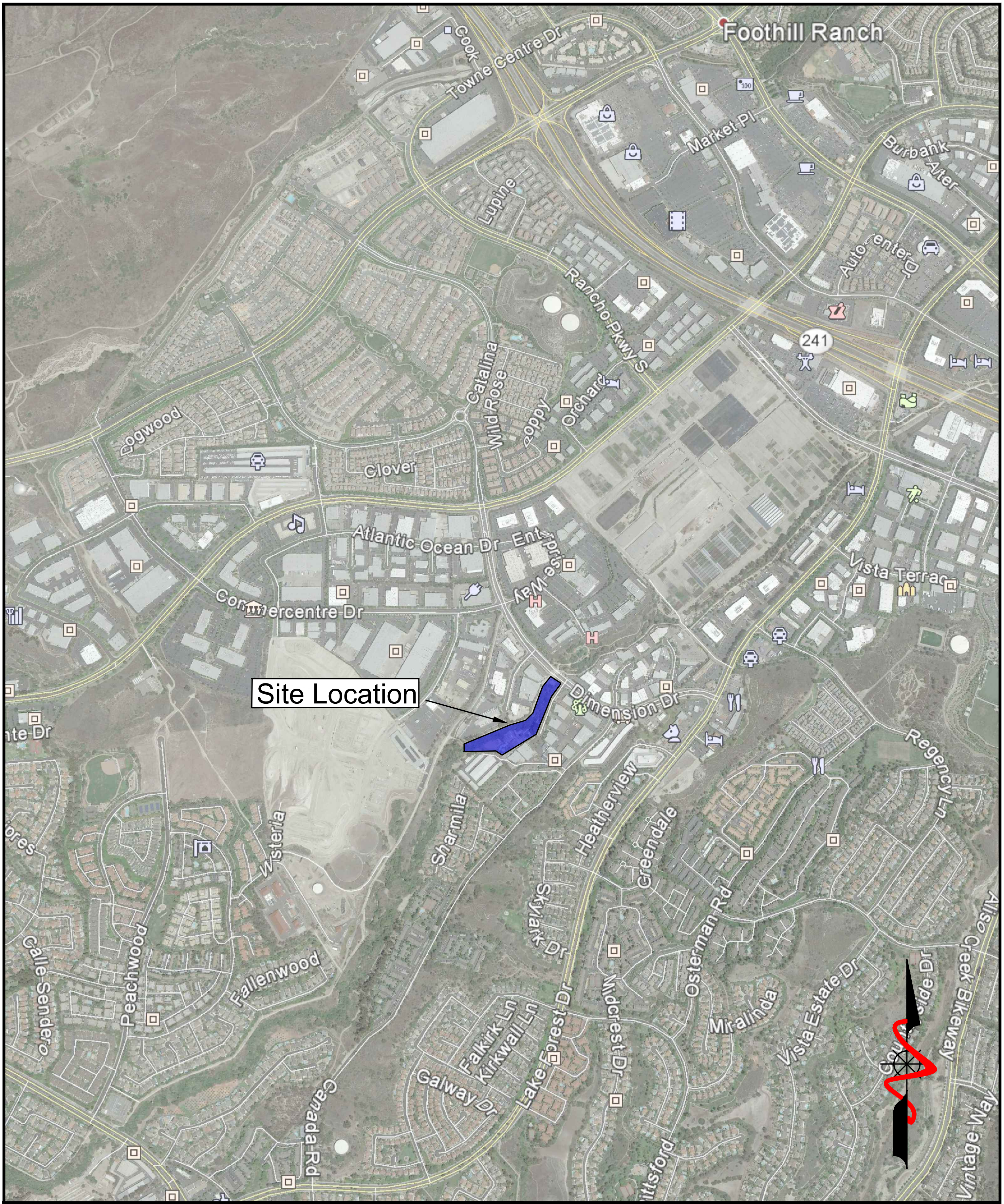
Based on review of historic aerials, it appears the barn structure was constructed some time before the year 1938 and the residential structure was constructed sometime between the years 1946 and 1952.

1.3 Project Description

Based on the conceptual site plan (Herdman, 2018), the proposed improvements include the construction of a restroom building addition, a modular office building, dump truck and boom truck parking areas, vehicular parking areas, a concrete pad for chip drying, freestanding block walls and a water quality basin/feature. The proposed development is located on the southern side of the existing Serrano Creek alignment. Design cuts and fills (not including required remedial grading) are anticipated to be on the order of 2 to 4 feet. The proposed temporary modular structures are anticipated to be relatively light with maximum column and wall loads of approximately 10 kips and 2 kips per linear foot, respectively. Please note no structural loads were provided to us at the time of this report.

Some of the existing structures including the barn (storage building) and residence (office) are anticipated to remain in-place and keep the same building footprint that currently exists.

The recommendations given in this report are based upon the estimated structural loading, grading and layout information above. We understand that the project plans are currently being developed at this time; LGC Geotechnical should be provided with updated project plans and any changes to structural loads when they become available, in order to either confirm or modify the recommendations provided herein.



LGC Geotechnical, Inc.

FIGURE 1
Site Location Map

PROJECT NAME	Great Scott - Lake Forest
PROJECT NO.	19035-01
ENG. / GEOL.	RLD / KTM
SCALE	Not to Scale
DATE	May 2019

1.4 Subsurface Geotechnical Evaluation

LGC Geotechnical performed a limited subsurface geotechnical evaluation of the site consisting of the excavation of three hollow-stem auger borings to evaluate onsite geotechnical conditions.

Three hollow-stem borings (HS-1, HS-2 & I-1) were drilled to depths ranging from approximately 5 to 50 feet below existing grade. An LGC Geotechnical staff engineer observed the drilling operations, logged the borings, and collected soil samples for laboratory testing. The borings were excavated by Calpac Drilling under subcontract to LGC Geotechnical using a truck-mounted drill rig equipped with 8-inch-diameter hollow-stem augers. Driven soil samples were collected by means of the Standard Penetration Test (SPT) and Modified California Drive (MCD) sampler generally obtained at 2.5 to 5-foot vertical increments. The MCD is a split-barrel sampler with a tapered cutting tip and lined with a series of 1-inch-tall brass rings. The SPT sampler (1.4-inch ID) and MCD sampler (2.4-inch ID, 3.0-inch OD) were driven using a 140-pound automatic hammer falling 30 inches to advance the sampler a total depth of 18 inches. The raw blow counts for each 6-inch increment of penetration were recorded on the boring logs. Bulk samples of the near-surface soils were also collected and logged at select borings for laboratory testing. At the completion of drilling, the borings were backfilled with the native soil cuttings and tamped. Some settlement of the backfill soils may occur over time.

Infiltration testing was performed within one of the borings (I-1) to a depth of 5 feet below existing grade. An LGC Geotechnical staff engineer installed standpipe, backfilled the boring with crushed rock and pre-soaked the infiltration hole prior to testing. Infiltration testing was performed per the County of Orange testing guidelines. The location was subsequently backfilled with native soils at the completion of testing.

The approximate locations of our subsurface explorations are provided on the Geotechnical Exploration Location Map (Figure 2). The boring logs are provided in Appendix B.

1.5 Laboratory Testing

Representative bulk and driven (relatively undisturbed) samples were obtained for laboratory testing during our field evaluation. Laboratory testing included in-situ moisture content and in-situ dry density, Atterberg Limits, fines content, expansion index, consolidation, R-value and corrosion (sulfate, chloride, pH and minimum resistivity).

The following is a summary of the laboratory test results:

- Dry density of the samples collected ranged from approximately 91 pounds per cubic foot (pcf) to 117 pcf, with an average of 106 pcf. Field moisture contents ranged from approximately 1 to 26 percent, with an average of 13 percent.
- Four fines content tests were performed and indicated a fines content (passing No. 200 sieve) ranging from approximately 6 to 37 percent. Based on the Unified Soils Classification System (USCS), the tested samples would be classified as “coarse-grained.”
- One Atterberg Limit (liquid limit and plastic limit) test was performed. Results indicated a Plasticity Index (PI) value of 17.
- One consolidation test was performed. The load versus deformation plot is provided in

Appendix C.

- Expansion potential testing indicated an expansion index value of 8, corresponding to "Very Low" expansion potential.
- One R-value test was performed on a bulk sample collected and resulted in an R-Value of 66.
- Corrosion testing indicated soluble sulfate contents of approximately 0.02 percent, a chloride content of 103 parts per million (ppm), pH of 8.2, and a minimum resistivity of 857 ohm-centimeters.

A summary of the laboratory test results is presented in Appendix C. The moisture and dry density results are presented on the boring logs in Appendix B.

2.0 GEOTECHNICAL CONDITIONS

2.1 Geologic Conditions

The subject site is located within the foothills of the Santa Ana Mountains, part of the Peninsular Ranges Geomorphic Province. The region consists of dissected foothills bordering the Los Angeles Basin to the northwest and the granite-core Santa Ana Mountains to the east. The Southern California Batholith forms the core of the Santa Ana Mountains, which is overlain by a thick sequence of sedimentary units, which comprise the foothills including the subject site. Late Miocene to Early Pliocene bedrock materials of the Oso Member of the Capistrano Formation that underlie the subject site at depth are primarily composed of sandstone and silty sandstone (USGS, 2004).

The site is specifically located within the Serrano Creek drainage course and the area just southeast of the active drainage. The southwest-flowing creek has deposited variable alluvial materials as observed during our subsurface investigation.

2.2 Generalized Subsurface Conditions

The subsurface evaluation performed at the subject site indicated that site soils consist of variable alluvium ranging from very moist to wet, moderate to dark brown clayey sand and sand, to an alluvial deposit consisting of light gray, relatively dry, medium to coarse sand with few pebbles. The material is labelled "younger alluvium" on boring logs. Bedrock of the Capistrano Formation, Oso Member was encountered at depth below the alluvium, consisting of light yellowish brown, silty sandstone, moist, very dense, observed to the maximum explored depth of approximately 50 feet below existing grade.

It should be noted that the borings are only representative of the location and time where/when they are performed and varying subsurface conditions may exist outside of the performed location. In addition, subsurface conditions can change over time. The soil descriptions provided above should not be construed to mean that the subsurface profile is uniform and that soil is homogeneous within the project area. For details on the stratigraphy at the exploration locations, refer to Appendix B.

2.3 Groundwater

Groundwater was encountered in our boring HS-1 at a depth of approximately 15 feet below existing grade. Historic high groundwater is estimated to be about 10 feet below existing grade (CDMG, 2000).

Seasonal fluctuations of groundwater elevations should be expected over time. In general, groundwater levels fluctuate with the seasons and local zones of perched groundwater may be present due to local seepage caused by irrigation and/or recent precipitation. Local perched groundwater conditions or surface seepage may develop once site development is completed.

2.4 Field Infiltration Testing

One field percolation test was performed in the area of the proposed infiltration trench and the location is depicted on Figure 2 – Geotechnical Exploration Location Map. Test well installation consisted of placing a 3-inch diameter perforated PVC pipe in the excavated borehole and backfilling the annulus with crushed rock including the placement of approximately 2 inches of crushed rock at the bottom of the borehole. The infiltration test well was presoaked the day of installation and testing took place within 24 hours of presoaking. During the pre-test the water level was observed to drop less than 6 inches in 25 minutes for two consecutive readings. Therefore, the test procedure for fine-grained soils or "slow test" was followed. Test well installation and the estimation of infiltration rates were accomplished in general accordance with the guidelines set forth by the County of Orange (2013). In general, three-dimensional flow out of the test well (*percolation*), as observed in the field, is mathematically reduced to one-dimensional flow out of the bottom of the test well (*infiltration*). Infiltration tests are performed using relatively clean water, free of particulates, silt, etc. The results of our recent field infiltration testing are presented in Appendix D and summarized below.

TABLE 1

Summary of Field Infiltration Testing

Infiltration Test Identification	Approx. Depth Below Existing Grade (ft)	Observed Infiltration Rate* (in./hr.)	Measured Infiltration Rate** (in./hr.)
I-1	5	0.7	0.35

*Observed Infiltration Rates Do Not Include Factor of Safety.

**Measured Infiltration Rates Include a Factor of Safety of 2 in Order to Evaluate Feasibility.

The tested infiltration rates provided in this report are considered a general representation of the infiltration rates at the location of the proposed infiltration trench. Please note, the testing of infiltration rates is highly dependent upon the materials encountered at the point of testing (i.e. location and depth of testing). Varying subsurface conditions may exist outside of the test location which could alter the calculated infiltration rate. Please refer to Section 4.6 for subsurface water infiltration recommendations.

2.5 Seismic Design Criteria

The site seismic characteristics were evaluated per the guidelines set forth in Chapter 16, Section 1613 of the 2016 California Building Code (CBC). Since the site contains soils that are susceptible to liquefaction (refer to above Section "Liquefaction and Dynamic Settlement"), ASCE 7 which has been adopted by the CBC requires that site soils be assigned Site Class "F" and a site-specific response spectrum be performed. However, in accordance with Section 20.3.1 of ASCE 7, if the fundamental periods of vibration of the planned structure are equal to or less than 0.5 second, a site-specific response spectrum is not required and ASCE 7/2016 CBC site class and seismic parameters may be used in lieu of a site-specific response spectrum. **It should be noted that the seismic parameters provided herein are not applicable for any structure having a fundamental period of vibration greater than 0.5 second.**

Representative site coordinates of latitude 33.6606 degrees north and longitude -117.6751 degrees west were utilized in our analyses. The maximum considered earthquake (MCE) spectral response accelerations (S_{MS} and S_{M1}) and adjusted design spectral response acceleration parameters (S_{DS} and S_{D1}) for Site Class D are provided in Table 2 below.

TABLE 2

Seismic Design Parameters for Structures with a Period of Vibration ≤ 0.5 Second

Selected Parameters from 2016 CBC, Section 1613 - Earthquake Loads	**Seismic Design Values**
Site Class per Chapter 20 of ASCE 7	D*
Risk-Targeted Spectral Acceleration for Short Periods (S_S)**	1.453g
Risk-Targeted Spectral Accelerations for 1-Second Periods (S_1)**	0.540g
Site Coefficient F_a per Table 1613.3.3(1)	1.0
Site Coefficient F_v per Table 1613.3.3(2)	1.5
Site Modified Spectral Acceleration for Short Periods (S_{MS}) for Site Class D [Note: $S_{MS} = F_a S_S$]	1.453g
Site Modified Spectral Acceleration for 1-Second Periods (S_{M1}) for Site Class D [Note: $S_{M1} = F_v S_1$]	0.811g
Design Spectral Acceleration for Short Periods (S_{DS}) for Site Class D [Note: $S_{DS} = (^2/_3) S_{MS}$]	0.968g
Design Spectral Acceleration for 1-Second Periods (S_{D1}) for Site Class D [Note: $S_{D1} = (^2/_3) S_{M1}$]	0.540g
Mapped Risk Coefficient at 0.2 sec Spectral Response Period, C_{RS} (per ASCE 7)	1.020
Mapped Risk Coefficient at 1 sec Spectral Response Period, C_{R1} (per ASCE 7)	1.052

* Site is Class F, seismic parameters provided herein are only applicable for structure period ≤ 0.5 second, refer to discussion above.

** From SEAOC, 2019

Section 1803.5.12 of the 2016 CBC (per Section 11.8.3 of ASCE 7) states that the maximum considered earthquake geometric mean (MCE_G) Peak Ground Acceleration (PGA) should be used for liquefaction potential. The PGA_M for the site is equal to 0.533g (SEAOC, 2019).

A deaggregation of the PGA based on a 2,475-year average return period indicates that an earthquake magnitude of 6.9 at a distance of approximately 5.4 km from the site would contribute the most to this ground motion (USGS, 2008).

2.6 Faulting

The subject site is not located within a State of California Earthquake Fault Zone (Alquist-Priolo) and no faults were identified on the site during our site evaluation (CGS, 2018). The possibility of damage due to ground rupture is considered low since no active faults are known to cross the site. The closest known active faults are associated with the San Joaquin Hills Fault, located approximately 3.1 miles from the site; the Elsinore Fault Zone, approximately 12.6 miles northeast of the site; and the Newport Inglewood Fault Zone, approximately 12.7 miles southwest of the site.

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the Southern California region, which may affect the site, include ground lurching and shallow ground rupture, soil liquefaction, and dynamic settlement. These secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependent on the distance between the site and causative fault and the onsite geology. A discussion of these secondary effects is provided in the following sections.

2.6.1 Liquefaction and Dynamic Settlement

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions coexist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose near-surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. In general, cohesive soils are not considered susceptible to liquefaction, depending on their plasticity and moisture content (Bray & Sancio, 2006). Effects of liquefaction on level ground include settlement, sand boils, and bearing capacity failures below structures. Dynamic settlement of dry loose sands can occur as the sand particles tend to settle and densify as a result of a seismic event.

Based on our review of the State of California Seismic Hazard Zone for liquefaction potential (CDMG, 2001), the site is located within a liquefaction hazard zone. In general, site soils are medium dense to dense and not susceptible to liquefaction. However, isolated loose sand layers are present and considered susceptible to liquefaction. The recent encountered in-situ groundwater depth of 15 feet below existing grade and historic high groundwater depth of 10 feet below existing grade were both used in the liquefaction analysis. The liquefaction evaluation was performed using data from boring HS-1. Liquefaction potential was evaluated using the procedures outlined by Special Publication 117A (SCEC, 1999 & CGS, 2008) and based on the seismic criteria of the 2016 California Building Code (CBC) and historic high groundwater depth. Liquefaction induced settlement was estimated using the PGA_M per the 2016 CBC and a moment magnitude of 6.9 (USGS, 2008).

Results indicate total seismic settlement on the order of 2-inches or less. Differential seismic settlement can be estimated as half of the total estimated settlement over a horizontal span of about 40 feet (i.e., 1-inch over a horizontal span of 40 feet). Seismically induced settlements were estimated by the procedure outlined by Tokimatsu and Seed (1987). Liquefaction calculations are provided in Appendix E.

2.6.2 Lateral Spreading

Lateral spreading is a type of liquefaction-induced ground failure associated with the lateral displacement of surficial blocks of sediment resulting from liquefaction in a subsurface layer. Once liquefaction transforms the subsurface layer into a fluid mass, gravity plus the earthquake inertial forces may cause the mass to move downslope towards a free face (such as a river channel or an embankment). Lateral spreading may cause large horizontal displacements and such movement typically damages pipelines, utilities, bridges, and structures.

Based on site liquefaction potential, lateral spreading and consequently zones of instability (horizontal displacements) near the banks of the adjacent creek are possible during the design basis earthquake ground motion. A corrected $(N_1)_{60}$ blow count of less than 15 is typically used for screening of potential lateral spreading (Youd, Hansen, Bartlett, 2002). Based on the obtained data, the soils within the lateral zone of the creek generally have corrected $(N_1)_{60}$ values of at least 15. Based on the obtained apparent density (i.e., blow counts) obtained from our field evaluation the potential for lateral spreading is generally considered low.

2.7 Expansion Potential

Based on the results of our recent laboratory testing, site soils are anticipated to have a "Very Low" expansion potential. Final expansion potential of site soils should be determined at the completion of grading. Results of expansion testing at finish grades will be utilized to confirm final foundation design.

3.0 <u>CONCLUSIONS</u>

Based on the results of our geotechnical evaluation, it is our opinion that the proposed development is feasible from a geotechnical standpoint, provided the following conclusions and recommendations are implemented.

The following is a summary of the primary geotechnical factors that may affect future development of the site:

- Groundwater was encountered during our subsurface evaluation at a depth of approximately 15 feet below existing ground surface. Historic high groundwater is estimated to be about 10 feet below existing grade (CDMG, 2000).
- The subject site is not located within a State of California Earthquake Fault Zone (Alquist-Priolo). The main seismic hazard that may affect the site is ground shaking from one of the active regional faults. The subject site will likely experience strong seismic ground shaking during its design life.
- Site soils are considered susceptible to liquefaction. The site is located in a State of California Seismic Hazard Zone for liquefaction. Total dynamic settlement is estimated to be on the order of 2-inches or less. Differential dynamic settlement can be estimated at half of the total settlement over a horizontal span of 40 feet for design of foundations.
- Based on the results of preliminary laboratory testing, site soils are anticipated to have "Very Low" expansion potential. Final design expansion potential must be determined at the completion of grading.
- From a geotechnical perspective, the existing onsite soils are suitable material for use as general fill (not retaining wall backfill), provided that they are relatively free from oversized material (larger than 8 inches in maximum dimension), construction debris, and significant organic material.
- Some portions of the onsite soils have high fines content and are not suitable for backfill of site retaining walls. Therefore, import and/or select grading and stockpiling of onsite sandy soils meeting project recommendations may be required.
- Excavations into the existing site soils should be feasible with heavy construction equipment in good working order.

4.0 <u>PRELIMINARY RECOMMENDATIONS</u>

The following recommendations are to be considered preliminary and should be confirmed upon completion of grading and earthwork operations. In addition, they should be considered minimal from a geotechnical viewpoint, as there may be more restrictive requirements from the architect, structural engineer, building codes, governing agencies, or the owner.

It should be noted that the following geotechnical recommendations are intended to provide sufficient information to develop the site in general accordance with the 2016 CBC requirements. With regard to the potential occurrence of potentially catastrophic geotechnical hazards such as fault rupture, earthquake-induced landslides, liquefaction, etc. the following geotechnical recommendations should provide adequate protection for the proposed development to the extent required to reduce seismic risk to an "acceptable level." The "acceptable level" of risk is defined by the California Code of Regulations as "that level that provides reasonable protection of the public safety, though it does not necessarily ensure continued structural integrity and functionality of the project" [Section 3721(a)]. Therefore, repair and remedial work of the proposed improvements may be required after a significant seismic event. With regards to the potential for less significant geologic hazards to the proposed development, the recommendations contained herein are intended as a reasonable protection against the potential damaging effects of geotechnical phenomena such as expansive soils, fill settlement, groundwater seepage, etc. It should be understood, however, that although our recommendations are intended to maintain the structural integrity of the proposed development and structures given the site geotechnical conditions, they cannot preclude the potential for some cosmetic distress or nuisance issues to develop as a result of the site geotechnical conditions.

The geotechnical recommendations contained herein must be confirmed to be suitable or modified based on the actual as-graded conditions.

4.1 <u>Site Earthwork</u>

We anticipate that earthwork at the site will consist of demolition of the existing site improvements, required earthwork removals, subgrade preparation, precise grading and construction of the proposed new improvements including the modular buildings, parking areas, subsurface utilities, water quality facilities, etc.

We recommend that earthwork be performed in accordance with the following recommendations, future grading plan review report(s), the 2016 CBC/City of Lake Forest grading requirements, and the General Earthwork and Grading Specifications included in Appendix F. In case of conflict, the following recommendations shall supersede those included in Appendix F. The following recommendations should be considered preliminary and may be revised based upon future evaluation and review of the project plans and/or based on the actual conditions encountered during site grading/construction.

4.1.1 <u>Site Preparation</u>

Prior to grading of areas to receive structural fill or engineered improvements, the areas should be cleared of existing building structures, asphalt, surface obstructions, and demolition debris. Vegetation and debris should be removed and properly disposed of off-site. Holes resulting from the removal of buried obstructions, which extend below proposed finish grades, should be replaced with suitable compacted fill material. Any abandoned sewer or storm drain lines should be completely removed and replaced with properly placed compacted fill. Deeper demolition may be required in order to remove existing foundations. We recommend the trenches associated with demolition which extend below the remedial grading depth be backfilled and properly compacted prior to the demolition contractor leaving the site.

If cesspools or septic systems are encountered during earthwork, they should be removed in their entirety. The resulting excavation should be backfilled with properly compacted fill soils. As an alternative, cesspools can be backfilled with lean sand-cement slurry. Any encountered wells should be properly abandoned in accordance with regulatory requirements. At the conclusion of the clearing operations, a representative of LGC Geotechnical should observe and accept the site prior to further grading.

4.1.2 Removal and Recompaction Depths and Limits

In order to provide a relatively uniform bearing condition for the planned building structures and improvements, we recommend the site soils be removed and recompacted.

Buildings: We recommend that soils within the proposed building addition areas and modular building pads be removed and recompacted to a minimum depth of 4 feet below existing grade or 3 feet beneath the base of the foundations, whichever is deeper. Where adequate space is available, the base of removal and recompaction bottoms should extend laterally a minimum distance equal to the depth of removal and recompaction below finish grade or at a minimum distance of 4 feet beyond the edges of the proposed building foundations, whichever is larger.

Minor Site Structures: For minor site structures such as free-standing, screen walls, trash enclosures, etc., removal and recompaction should extend at least 3 feet beneath the existing grade or 2 feet beneath the base of foundations, whichever is deeper. In general, the envelope for removal and recompaction should extend laterally a minimum distance of 3 feet beyond the edges of the proposed improvements mentioned above, where space permits.

Pavement and Hardscape: Within pavement areas, removal and recompaction should extend to a depth of at least 1 foot below the existing grade or 1 foot beneath the finished subgrade (i.e., beneath planned aggregate base/asphalt concrete or gravel). Within hardscape areas, removal and recompaction should extend to a depth of at least 1 foot below the existing grade or 1 foot beneath the finished subgrade (i.e., beneath planned concrete).

Local conditions may be encountered during excavation that could require deep remedial grading beyond the above noted minimum in order to obtain an acceptable subgrade. The actual depths and lateral extents of grading will be determined by the geotechnical consultant, based on subsurface conditions encountered during grading. Removal and recompaction areas should be accurately staked in the field by the Project Surveyor.

4.1.3 Temporary Excavations

Temporary excavations should be performed in accordance with project plans, specifications, and all Occupational Safety and Health Administration (OSHA) requirements. Excavations should be laid back or shored in accordance with OSHA requirements before personnel or equipment are allowed to enter. Based on our field investigation, the majority of site soils are anticipated to be OSHA Type "B" soils (refer to the attached boring logs). Sandy soils are present and should be considered susceptible to caving. Raveling of the sandy soils should be anticipated for temporary slopes. Flatter slope inclinations should be considered if raveling cannot be tolerated. The exposed slope surface may be kept surficially moist (but not saturated) during construction to reduce (not eliminate) potential sloughing. Soil conditions should be regularly evaluated during construction to verify conditions are as anticipated. The contractor shall be responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Close coordination with the geotechnical consultant should be maintained to facilitate construction while providing safe excavations. Excavation safety is the sole responsibility of the contractor.

Surcharge loads (vehicular traffic, soil stockpiles, construction equipment, etc.) should be set back from the perimeter of excavations a minimum distance equivalent to a 1:1 projection from the bottom of the excavation or 5 feet, whichever is greater, unless the cut is properly shored and designed for the applicable surcharge load. Once an excavation has been initiated, it should be backfilled as soon as practical. Prolonged exposure of temporary excavations may result in some localized instability. Excavations should be planned so that they are not initiated without sufficient time to shore/fill them prior to weekends, holidays, or forecasted rain.

It should be noted that any excavation that extends below a 1:1 (horizontal to vertical) projection of an existing foundation will remove existing support of the structure foundation. If requested, temporary shoring parameters will be provided.

4.1.4 Removal Bottoms and Subgrade Preparation

In general, removal bottoms and areas to receive compacted fill should be scarified to a minimum depth of 6 inches, brought to a near-optimum moisture condition (generally within optimum and 2 percent above optimum moisture content), and re-compacted per project recommendations.

Removal bottoms and areas to receive fill should be observed and accepted by the geotechnical consultant prior to subsequent fill placement. Soil subgrade for planned footings and improvements (e.g., slabs, etc.) should be firm and competent.

4.1.5 Material for Fill

From a geotechnical perspective, the onsite soils are generally considered suitable for use as general compacted fill, provided they are screened of significant organic materials, construction debris and oversized material (8 inches in greatest dimension).

From a geotechnical viewpoint, any required import soils for general fill (i.e., non-retaining wall backfill) should consist of soils of "Very Low" expansion potential (expansion index 20 or less based on American Society for Testing and Materials [ASTM] D 4829), and free of significant organic materials, construction debris and any material greater than 3 inches in maximum dimension. Import for any required retaining wall backfill should meet the criteria outlined in the following paragraph. Source samples should be provided to the geotechnical consultant for laboratory testing a minimum of four working days prior to any planned importation.

Retaining wall backfill should consist of imported or onsite free draining, clean granular (sandy) soils with a maximum of 35 percent fines (passing the No. 200 sieve) per ASTM Test Method D1140 (or ASTM D6913/D422) and a "Very Low" expansion potential (EI of 20 or less per ASTM D4829). Soils should also be screened of significant organic materials, construction debris, and any material greater than 3 inches in maximum dimension. The site contains soils that are not suitable for retaining wall backfill due to their fines content; therefore, select grading and stockpiling and/or import of soils meeting the criteria outlined above will be required by the contractor for obtaining suitable retaining wall backfill soil. These preliminary findings should be confirmed during grading.

Aggregate base (crushed aggregate base or crushed miscellaneous base) should conform to the requirements of Section 200-2 of the most recent version of the Standard Specifications for Public Works Construction ("Greenbook") for untreated base materials (except processed miscellaneous base) and/or City of Lake Forest requirements.

The placement of inert demolition materials in compacted fill is acceptable from a geotechnical viewpoint provided the demolition material is broken up into pieces not larger than typically used for aggregate base (approximately 1-inch in maximum dimension) and well blended into fill soils with essentially no resulting voids. Demolition material placed in fills must be free of construction debris (wood, organics, etc.) and reinforcing steel. If asphalt concrete fragments will be incorporated into the demolition materials, approval from an environmental viewpoint may be required and is not the purview of the geotechnical consultant. From our previous experience, we recommend that asphalt concrete fragments be limited to fill areas within planned parking and drive aisle areas (i.e., not within building pad areas).

4.1.6 Placement and Compaction of Fills

Material to be placed as fill should be brought to near-optimum moisture content (generally within optimum and 2 percent above optimum moisture content) and recompacted to at least 90 percent relative compaction (per ASTM D1557). Moisture conditioning of site soils will be required in order to achieve adequate compaction. Drying and or mixing of very moist soils will be required prior to reusing the materials in compacted fills. Soils are also present that will require additional moisture in order to achieve the required compaction.

The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in compacted thickness. Each lift should be thoroughly compacted and accepted prior to subsequent lifts. Generally, placement and compaction of fill should be performed in accordance with local grading ordinances and with observation and testing performed by the geotechnical consultant. Oversized material as previously defined should be removed from site fills.

During backfill of excavations, the fill should be properly benched into firm and competent soils of temporary backcut slopes as it is placed in lifts.

Aggregate base material should be compacted to at least 95 percent relative compaction at or slightly above optimum moisture content per ASTM D1557. Subgrade below aggregate base should be compacted to at least 90 percent relative compaction per ASTM D1557 at near-optimum moisture content (generally within optimum and 2 percent above optimum moisture content).

4.1.7 Trench and Retaining Wall Backfill and Compaction

The onsite soils may generally be suitable as trench backfill, provided the soils are screened of rocks, construction debris, other material greater than 6 inches in diameter and significant organic matter. If trenches are shallow or the use of conventional equipment may result in damage to the utilities, sand having a sand equivalent (SE) of 30 or greater (per California Test Method [CTM] 217) may be used to bed and shade the pipes. Based on our field evaluation, onsite soils will not meet this sand equivalent requirement. Sand backfill within the pipe bedding zone may be densified by jetting or flooding and then tamping to ensure adequate compaction. Subsequent trench backfill should be compacted in uniform lifts (as outlined above in section "Placement and Compaction of Fills") by mechanical means to at least 90 percent relative compaction (per ASTM D1557).

Utility trenches running parallel to footings should not be excavated within a 1:1 (horizontal to vertical) downward projection from adjacent footings ("footing influence zone") to avoid potential undermining. Depending on the utility line and structural loading of the footing, utility trenches running perpendicular to footings may require special provisions such as sand-cement slurry backfill of the utility trench in this zone or flexible sleeves through the footings. These conditions should be evaluated on a case-by-case basis.

Retaining wall backfill should consist of sandy soils as outlined in preceding Section 4.1.5. The limits of select sandy backfill should extend at minimum ½ the height of the retaining wall or the width of the heel (if applicable), whichever is greater (Figure 3). Retaining wall backfill soils should be compacted in relatively uniform thin lifts to at least 90 percent relative compaction (per ASTM D1557). Jetting or flooding of retaining wall backfill materials should not be permitted.

In backfill areas where mechanical compaction of soil backfill is impractical due to space constraints, typically sand-cement slurry may be substituted for compacted backfill. The slurry should contain about one sack of cement per cubic yard. When set, such a mix typically has the consistency of compacted soil. Sand cement slurry placed near the surface within landscape areas should be evaluated for potential impacts on planned improvements.

A representative from LGC Geotechnical should observe, probe, and test the backfill to verify compliance with the project recommendations.

4.2 Preliminary Foundation Recommendations

The proposed building additions and modular structures may be supported on a conventional slab and spread footings or a mat slab, provided earthwork is performed in accordance with the recommendations presented in this report. All footings should be supported on properly compacted fill. Please note that the following foundation recommendations are preliminary and must be confirmed by LGC Geotechnical at the completion of grading.

Preliminary foundation recommendations are provided in the following sections. The foundation design must be performed by the structural engineer based on the following geotechnical parameters and minimum values provided.

4.2.1 Slab Design and Construction

We recommend building additions be founded on a conventional slab with a minimum thickness of 4 inches. We recommend the prefabricated modular buildings (office structures, etc.) be founded on a mat slab a minimum thickness of 6 inches. Conventional slabs and mat slabs are to be supported on compacted fill soils properly prepared in accordance with the recommendations provided in this report. Minimum slab reinforcement should be determined by the structural engineer based on the imposed loading, crack control, etc.

It is recommended that subgrade soils below mat slabs be moisture conditioned in order to maintain the recommended moisture content up to the time of concrete placement. The recommended moisture content of the mat slab subgrade soils should be approximately 0 to 4 percent above optimum moisture content to a minimum depth of 12 inches. The moisture content of the mat slab subgrade should be verified by the geotechnical engineer within 1 to 2 days prior to concrete placement. In addition, this moisture content should be maintained around the immediate perimeter of the mat slabs during construction.

4.2.2 Slab Underlayment Guidelines

The following is for informational purposes only since slab underlayment (e.g., moisture retarder, sand or gravel layers for concrete curing and/or capillary break) is unrelated to the geotechnical performance of the foundation and thereby not the purview of the geotechnical consultant. Post-construction moisture migration should be expected below the foundation. The foundation engineer should determine whether the use of a capillary break (sand or gravel layer), in conjunction with the vapor retarder, is necessary or required by code. Sand layer thickness and location (above and/or below vapor retarder) should also be determined by the foundation engineer/architect.

4.3 Soil Bearing and Lateral Resistance

Provided our earthwork recommendations are implemented, an allowable soil bearing pressure of 2,000 pounds per square foot (psf) may be used for the design of footings having a minimum width of 12 inches and minimum embedment of 12 inches below lowest adjacent ground surface. These allowable bearing pressures are applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. Bearing values indicated are for total dead loads and frequently applied live loads and may be increased by ⅓ for short duration loading (i.e., wind or seismic loads).

In utilizing the above-mentioned allowable bearing capacity and provided our earthwork recommendations are implemented, foundation settlement due to structural loads is anticipated to be ½-inch or less. Differential settlement may be taken as half of the total settlement (i.e., ¼-inch over a horizontal span of 40 feet).

Resistance to lateral loads can be provided by friction acting at the base of foundations and by passive earth pressure. For concrete/soil frictional resistance, an allowable coefficient of friction of 0.3 may be assumed with dead-load forces. For slabs constructed over a moisture retarder, the allowable friction coefficient should be provided by the manufacturer. An allowable passive lateral earth pressure of 225 psf per foot of depth (or pcf) to a maximum of 2,250 psf may be used for lateral resistance. Allowable passive pressure may be increased to 300 pcf to a maximum of 3,000 psf for short duration seismic or wind loading. These passive pressures are applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. For a 2:1 (horizontal to vertical) downward sloping condition, a reduced allowable passive lateral earth pressure of 100 pcf to a maximum of 1,000 psf may be used. We recommend that the upper foot of passive resistance be neglected if finished grade will not be covered with concrete or asphalt. Frictional resistance and passive pressure may be used in combination without reduction. The provided allowable passive pressures are based on a factor of safety of 1.5 and 1.1 for static and seismic loading conditions, respectively. The structural designer should incorporate appropriate factors of safety and/or load factors in their design.

4.4 Lateral Earth Pressures for Retaining Walls

The following may be used for design of site retaining walls. Lateral earth pressures are provided as equivalent fluid unit weights, in psf per foot of depth (or pcf). These values do not contain an appreciable factor of safety, so the retaining wall designer should apply the applicable factors of safety and/or load factors during design. A soil unit weight of 120 pcf may be assumed for calculating the actual weight of soil over the wall footing.

The following lateral earth pressures are presented in Table 3 for approved import or onsite free draining, clean granular (sandy) soils with a maximum of 35 percent fines (passing the No. 200 sieve per ASTM D-421/422) and a "Very Low" expansion potential (EI of 20 or less per ASTM D4829). Portions of the onsite soils are not suitable for retaining wall backfill due to their fines content. Therefore, select grading and stockpiling and/or import of soils meeting the criteria outlined above will be required by the contractor for obtaining suitable retaining wall backfill soil. The wall designer should clearly indicate on the retaining wall plans the required select sandy soil backfill criteria. These preliminary findings should be confirmed during grading.

TABLE 3

Lateral Earth Pressures – Approved Sandy Soils

Conditions	**Equivalent Fluid Unit Weight (pcf)**	**Equivalent Fluid Unit Weight (pcf)**
	Level Backfill	**2:1 Sloped Backfill**
	Approved Sandy Soils	**Approved Sandy Soils**
Active	35	55
At-Rest	55	70

If the wall can yield enough to mobilize the full shear strength of the soil, it can be designed for "active" pressure. If the wall cannot yield under the applied load, the earth pressure will be higher. This would include 90-degree corners of retaining walls. Such walls should be designed for "at-rest." The equivalent fluid pressure values assume free-draining conditions and a drainage system will be installed and maintained to prevent the build-up of hydrostatic pressures. If conditions other than those assumed above are anticipated, the equivalent fluid pressure values should be provided on an individual-case basis by the geotechnical engineer.

Retaining wall structures should be provided with appropriate drainage and appropriately waterproofed. To reduce, but not eliminate, saturation of near-surface (upper approximate 1-foot) soils in front of the retaining walls, the perforated subdrain pipe should be located as low as possible behind the retaining wall. The outlet pipe should be sloped to drain to a suitable outlet. In general, we do not recommend retaining wall outlet pipes be connected to area drains. If subdrains are connected to area drains, special care should be taken to maintain these drains. Typical conventional retaining wall drainage is shown on Figure 3. It should be noted that the recommended subdrain does not provide protection against seepage through the face of the wall and/or efflorescence. Waterproofing and outlet systems are not the purview of the geotechnical consultant.

Surcharge loading effects from any adjacent structures should be evaluated by the retaining wall designer. In general, structural loads within a 1:1 (horizontal: vertical) upward projection from the bottom of the proposed retaining wall footing will surcharge the proposed retaining wall. In addition to the recommended earth pressure, retaining walls adjacent to streets should be designed to resist a uniform lateral pressure of 85 pounds per square foot (psf) due to normal street vehicle traffic, if applicable. Uniform lateral surcharges may be estimated using the applicable coefficient of lateral earth pressure using a rectangular distribution. A factor of 0.45 and 0.3 may be used for at-rest and active conditions, respectively. The retaining wall designer should contact the geotechnical consultant for any required geotechnical input in estimating surcharge loads.

If required, the retaining wall designer may use a seismic lateral earth pressure increment of 10 pcf for a level backfill condition. This increment should be applied in addition to the provided static lateral earth pressure using a triangular distribution with the resultant acting at H/3 in relation to the base of the retaining structure (where H is the retained height). Per Section 1803.5.12 of the 2016 CBC, the seismic lateral earth pressure is applicable to structures assigned to Seismic Design Category D through F for retaining wall structures supporting more than 6 feet of backfill height. The provided seismic lateral earth pressure should not be used for retaining walls exceeding 10 feet in height. If a retaining wall greater than 10 feet in height is proposed or a retaining wall with a sloping backfill condition, the retaining wall designer should contact the geotechnical engineer for specific seismic lateral earth pressure increments based on the configuration of the planned retaining wall structures. This seismic lateral earth pressure is estimated using the procedure outlined by the Structural Engineers Association of California (Lew, et al, 2010).

Soil bearing and lateral resistance (friction coefficient and passive resistance) are provided in Section 4.3 (Soil Bearing and Lateral Resistance). Earthwork considerations (temporary backcuts, backfill, compaction, etc.) for retaining walls are provided in Section 4.1 (Site Earthwork) and the subsequent earthwork related sub-sections.

4.5 Soil Corrosivity

Although not corrosion engineers (LGC Geotechnical is not a corrosion consultant), several governing agencies in Southern California require the geotechnical consultant to determine the corrosion potential of soils to buried concrete and metal facilities. We therefore present the results of our testing with regard to corrosion for the use of the client and other consultants, as they determine necessary.

Corrosion testing of a near-surface bulk sample indicated a soluble sulfate content less than approximately 0.02 percent, a chloride content of 103 parts per million (ppm), pH of 8.2, and a minimum resistivity of 857 ohm-centimeters. Based on Caltrans Corrosion Guidelines (Caltrans, 2015), soils are considered corrosive to structural elements if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm (0.2 percent) or greater. Based on the preliminary test results, soils are not considered corrosive using Caltrans criteria.

Based on laboratory sulfate test results, the near surface soils are designated to a class “S0” per ACI 318, Table 19.3.1.1 with respect to sulfates. Concrete in direct contact with the onsite soils can be designed according to ACI 318, Table 19.3.2.1 using the “S0” sulfate classification.

Laboratory testing may need to be performed at the completion of grading by the project corrosion engineer to further evaluate the as-graded soil corrosivity characteristics.

Accordingly, revision of the corrosion potential may be needed, should future test results differ substantially from the conditions reported herein. The client and/or other members of the development team should consider this during the design and planning phase of the project and formulate an appropriate course of action.

4.6 ***Control of Surface Water and Drainage Control***

From a geotechnical perspective, we recommend that compacted finished grade soils adjacent to the proposed warehouse structures be sloped away from the proposed structures towards an approved drainage device or unobstructed swale. Drainage swales, wherever feasible, should not be constructed within 5 feet of buildings. Where lot and building geometry necessitates that the drainage swales be routed closer than 5 feet to structural foundations, we recommend the use of area drains together with drainage swales. Drainage swales used in conjunction with area drains should be designed by the project civil engineer so that a properly constructed and maintained system will prevent ponding within 5 feet of the foundation. Code compliance of grades is not the purview of the geotechnical consultant.

Planters with open bottoms adjacent to buildings should be avoided. Planters should not be designed adjacent to buildings unless provisions for drainage, such as catch basins, liners, and/or area drains, are made. Overwatering must be avoided.

4.7 ***Subsurface Water Infiltration***

Recent regulatory changes in some jurisdictions have recommended that low flow runoff be infiltrated rather than discharged via conventional storm drainage systems. In general, the vast majority of geotechnical distress issues are directly related to improper drainage. In general, distress in the form of movement of improvements could occur as a result of soil saturation and loss of soil support, expansion, internal soil erosion, collapse and/or settlement. Infiltrated water may enter underground utility pipe zones and migrate along the pipe backfill, potentially impacting other improvements located far away from the point of infiltration.

Geotechnical stability and integrity of the project site is reliant upon appropriate handling of surface water. Due to the low infiltration rate, shallow groundwater and site liquefaction potential, we strongly recommend against the intentional infiltration of storm water.

4.8 ***Preliminary Asphalt Concrete Pavement Sections***

The following provisional minimum asphalt concrete (AC) street sections are provided in Table4 for Traffic Indices (TI) of 5.5, 6.0 and 6.5 to be utilized in the design of the auto and truck parking/circulation areas. These sections are based on an assumed R-value of 50. These recommendations must be confirmed with R-value testing of representative near-surface soils at the completion of grading and after underground utilities have been installed and backfilled. Final pavement sections should be confirmed by the project civil engineer based upon the final design Traffic Index. If requested, LGC Geotechnical will provide sections for alternate TI values.

TABLE 4

Preliminary Asphalt Concrete Pavement Section Options

Assumed Traffic Index	5.5	6.0	6.5
R -Value Subgrade	50	50	50
AC Thickness	4.0 inches	4.0 inches	4.0 inches
Aggregate Base Thickness	4.0 inches	4.0 inches	4.5 inches

The pavement section thicknesses provided above are considered minimum thicknesses. Increasing the thickness of any or all of the above layers will reduce the likelihood of the pavement experiencing distress during its service life. The above recommendations are based on the assumption that proper maintenance and irrigation of the areas adjacent to the roadway will occur throughout the design life of the pavement. Failure to maintain a proper maintenance and/or irrigation program may jeopardize the integrity of the pavement.

Earthwork recommendations regarding aggregate base and subgrade are provided in the previous Section "Site Earthwork" and the related sub-sections of this report.

4.9 Preliminary Gravel Parking Area Recommendations

It is our understanding that the equipment parking areas will consist of compacted gravel (1-inch to 1 ½-inch) over compacted subgrade and asphalt concrete paving is not desired. A minimum of 4 inches of compacted gravel over compacted subgrade is recommended.

The thickness shown is a minimum thickness. Increasing the thickness of the above will reduce the likelihood of the equipment parking area experiencing distress during its service life. The above recommendations are based on the assumption that proper maintenance and irrigation of the areas adjacent to the equipment parking areas will occur through the design life of the pavement. Failure to maintain a proper maintenance and/or irrigation program may jeopardize the integrity of the equipment parking areas.

Earthwork recommendations regarding aggregate base and subgrade are provided in the previous Section "Site Earthwork" and the related sub-sections of this report.

4.10 Nonstructural Concrete Flatwork

Nonstructural concrete flatwork (such as walkways, patio slabs, etc.) has a potential for cracking due to changes in soil volume related to soil-moisture fluctuations. To reduce the potential for excessive cracking and lifting, concrete may be designed in accordance with the minimum guidelines outlined in Table 5. These guidelines will reduce the potential for irregular cracking and promote cracking along construction joints, but will not eliminate all cracking or lifting. Thickening the concrete and/or adding additional reinforcement will further reduce cosmetic distress.

TABLE 5

Preliminary Geotechnical Parameters for Nonstructural Concrete Flatwork Placed on Very Low to Low Expansion Potential Subgrade

	Sidewalks	Private Drives	Patios/ Entryways	City Sidewalk Curb and Gutters
Minimum Thickness (in.)	4 (nominal)	4 (full)	4 (full)	City/Agency Standard
Presoaking	Wet down prior to placing	Wet down prior to placing	Wet down prior to placing	City/Agency Standard
Reinforcement	—	No. 3 at 24 inches on centers	No. 3 at 24 inches on centers	City/Agency Standard
Thickened Edge (in.)	—	8 x 8	—	City/Agency Standard
Crack Control Joints	Saw cut or deep open tool joint to a minimum of $^1/_3$ the concrete thickness	Saw cut or deep open tool joint to a minimum of $^1/_3$ the concrete thickness	Saw cut or deep open tool joint to a minimum of $^1/_3$ the concrete thickness	City/Agency Standard
Maximum Joint Spacing	5 feet	10 feet or quarter cut whichever is closer	6 feet	City/Agency Standard
Aggregate Base Thickness (in.)	—	—	—	City/Agency Standard

4.11 Geotechnical Plan Review

When available, project plans (grading, foundation, retaining wall, etc.) should be reviewed by this office prior to construction to verify that our geotechnical recommendations have been incorporated. Additional field work and/or modified geotechnical recommendations may be necessary.

4.12 Geotechnical Observation and Testing During Construction

The recommendations provided in this report are based on limited subsurface observations and geotechnical analysis. The interpolated subsurface conditions should be checked in the field during construction by a representative of LGC Geotechnical. Geotechnical observation and testing is required per Section 1705 of the 2016 California Building Code (CBC).

Geotechnical observation and/or testing should be performed by LGC Geotechnical at the following stages:

- During grading (removal and recompaction bottoms, fill placement, etc.);
- During retaining wall backfill and compaction;
- During utility trench backfill and compaction;
- After moisture conditioning building pads and other concrete-flatwork subgrades, and prior to placement of aggregate base or concrete;
- Preparation of pavement subgrade and placement of aggregate base;
- After building and wall footing excavation and prior to placing steel reinforcement and/or concrete; and
- When any unusual soil conditions are encountered during any construction operation subsequent to issuance of this report.

5.0 LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable soils engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

This report is based on data obtained from limited observations of the site, which have been extrapolated to characterize the site. While the scope of services performed is considered suitable to adequately characterize the site geotechnical conditions relative to the proposed development, no practical evaluation can completely eliminate uncertainty regarding the anticipated geotechnical conditions in connection with a subject site. Variations may exist and conditions not observed or described in this report may be encountered during grading and construction.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the other consultants (at a minimum the civil engineer, structural engineer, landscape architect) and incorporated into their plans. The contractor should properly implement the recommendations during construction and notify the owner if they consider any of the recommendations presented herein to be unsafe, or unsuitable.

The findings of this report are valid as of the present date. However, changes in the conditions of a site can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. The findings, conclusions, and recommendations presented in this report can be relied upon only if LGC Geotechnical has the opportunity to observe the subsurface conditions during grading and construction of the project, in order to confirm that our preliminary findings are representative for the site. This report is intended exclusively for use by the client, any use of or reliance on this report by a third party shall be at such party's sole risk.

In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and modification.

LEGEND

Propo□ed Location of Hollo□ Stem Boring by LGC Geotechnical□ □ith Appro□imate Propo□ed Depth in □eet

Propo□ed Location of Hollo□ Stem Auger Infiltration Boring by LGC Geotechnical□□ith Appro□imate Propo□ed Depth in □eet

LGC Geotechnical, Inc.
131 Calle Iglesia, Ste. 200
San Clemente, CA 92672
TEL (949) 369-6141 FAX (949) 369-6142

FIGURE 2
Geotechnical Exploration Location Map

PROJECT NAME	Great Scott - Lake Forest
PROJECT NO.	19035-01
ENG. / GEOL.	RLD / KTM
SCALE	Not to Scale
DATE	May 2019

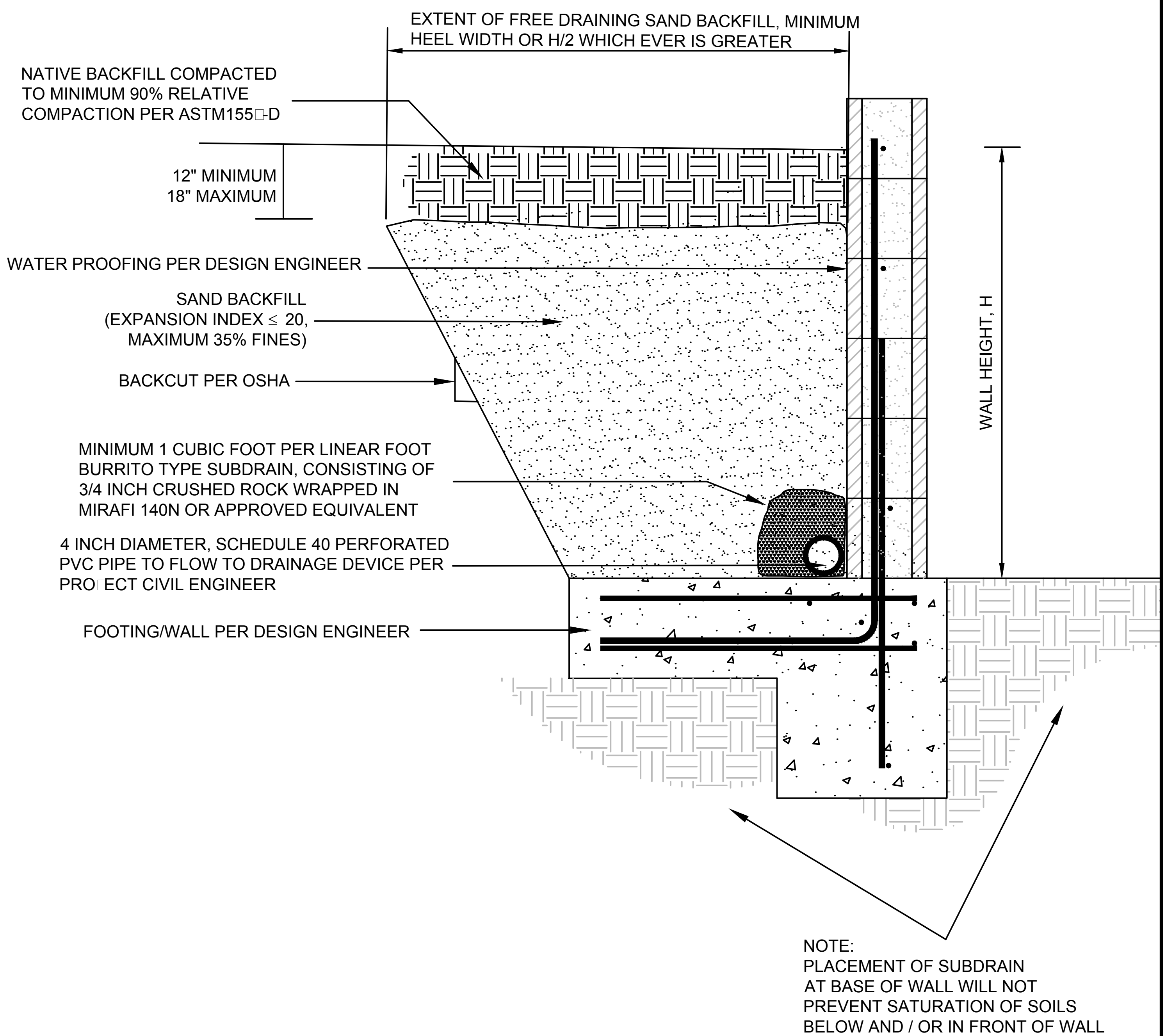


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FIGURE 3
Retaining Wall Detail

PROJECT NAME	Great Scott - Lake Forest
PROJECT NO.	19035-01
ENG.	RLD
SCALE	Not to Scale
DATE	May 2019

Appendix A
References

APPENDIX A

<u>References</u>

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Appendix B
Field Exploration Logs

Geotechnical Boring Log Borehole HS-1

Date: 4/8/2019	**Drilling Company:** Cal Pac
Project Name: Great Scott - Lake Forest	**Type of Rig:** Track Rig
Project Number: 19035-01	**Drop:** 30" **Hole Diameter:** 8"
Elevation of Top of Hole: ~631' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 1 of 2

Logged By BPP
Sampled By BPP
Checked By RLD

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
630	0	B-1					SP-SC	**@0' to □0' - <u>Quaternary Alluvium (Qal)</u>** @0' - Silty SAND: dark brown, slightly moist	EI,CR
			R-1	5 6 6	111.8	12.1	SM	@2.5' - Silty SAND: gray, moist, loose	
625	5		R-2	2 3 3	98.2	14.2		@5' - Silty SAND: brown, very moist, loose	
			R-3	2 4 □	112.2	14.6	SC	@□.5' - Clayey SAND: dark olive brown, very moist, loose	CN
620	10		R-4	2 2 3	101.8	21.8		@10' - Clayey SAND: brown, very moist, loose	-#200
615	15	(groundwater symbol)	SPT-1	2 2 3		26.2	CL	@15' - Sandy CLAY: brown, wet, medium stiff□ groundwater	AL
610	20		R-5	11 12 11	112.□	15.1	SP-SM	@20' - SAND with Silt: light brown, wet, medium dense	-#200
605	25		SPT-2	5 11 12		18.4	SM	@25' - Silty SAND: brown, wet, medium dense	-#200
	30							**@□0' to T.D. - <u>Tertiary Capi□trano □ormation□□ □o Member (Tco)</u>**	

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:
- B BULK SAMPLE
- R RING SAMPLE (CA Modified Sampler)
- G GRAB SAMPLE
- SPT STANDARD PENETRATION TEST SAMPLE
- (symbol) GROUNDWATER TABLE

TEST TYPES:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- SA SIEVE ANALYSIS
- S&H SIEVE AND HYDROMETER
- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 4/25/2019

Geotechnical Boring Log Borehole HS-1

Date: 4/8/2019	**Drilling Company:** Cal Pac
Project Name: Great Scott - Lake Forest	**Type of Rig:** Track Rig
Project Number: 19035-01	**Drop:** 30" **Hole Diameter:** 8"
Elevation of Top of Hole: ~631' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	

Logged By BPP
Sampled By BPP
Checked By RLD

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
600	30		R-6	9 11 22	117.0	14.5	SC	@30' - Clayey SAND with some gravel: gray-brown, wet, medium dense; extremely weathered bedrock	-#200
595	35		SPT-3	3 11 27		17.2	SM	@35' - Silty SAND: yellowish brown, wet, dense	
590	40		R-7	50/2"	105.4	24.8	SC	@40' - Clayey SAND: gray-brown with iron oxide staining, wet, very dense; slightly weathered bedrock	
585	45		SPT-4	50/6"		17.5		@45' - Clayey SAND: gray with iron oxide staining, wet, very dense @47' - Auger Refusal	
580	50							Total Depth = 50' Groundwater Encountered at Approximately 15' Backfilled with Cuttings on 4/8/2019	
575	55								
	60								

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- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Geotechnical Boring Log Borehole HS-□

Date: 4/8/2019	**Drilling Company:** Cal Pac
Project Name: Great Scott - Lake Forest	**Type of Rig:** Track Rig
Project Number: 19035-01	**Drop:** 30" **Hole Diameter:** 8"
Elevation of Top of Hole: ~646' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 1 of 1

Logged By BPP
Sampled By BPP
Checked By N/A

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
645	0	B-1					SM	**@0' to T.D. - Quaternary Young Alluvium (Qya)** @0' - Silty SAND with Gravel: brown and dry	RV
			R-1	8 8 12	105.6	0.8	SP	@2.5' - SAND: pinkish-brown, dry, medium dense	
640	5		R-2	□ □ 9	100.0	2.4		@5' - SAND: light brown, dry, medium dense	
			R-3	□ 9 12	103.0	1.1		@□.5' - SAND: yellowish brown, dry, medium dense	
635	10		R-4	□ 13 14	91.4	0.□		@10' - SAND: pinkish gray, dry, medium dense	
630	15							Total Depth = 10' Groundwater Not Encountered Backfilled with Cuttings on 4/8/2019	
625	20								
620	25								
	30								

LGC Geotechnical, Inc.

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- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 4/25/2019

Geotechnical Boring Log Borehole I-1

Date: 4/8/2019	**Drilling Company:** Cal Pac
Project Name: Great Scott - Lake Forest	**Type of Rig:** Track Rig
Project Number: 19035-01	**Drop:** 30" **Hole Diameter:** 8"
Elevation of Top of Hole: ~630' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 1 of 1

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	Logged By BPP Sampled By BPP Checked By N/A DESCRIPTION	Type of Test
	0						SM	**@0' to T.D. - Quaternay Alluvium (Qal)** @0' - Silty SAND: brown and moist	
			R-1	2 2 3	110.6	10.2		@2.5' - Silty SAND: gray-brown, wet, very loose	
625	5							Total Depth = 5' Groundwater Not Encountered Backfilled with Cuttings on 4/8/2019	
620	10								
615	15								
610	20								
605	25								
	30								

Geotechnical, Inc.

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- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 4/25/2019

Appendix C
Laboratory Test Results

APPENDIX C

Laboratory Test Results

The laboratory testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soils. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of the test type and a table summarizing the test results.

Moisture and Density Determination Tests: Moisture content (ASTM D2216) and dry density determinations (ASTM D2937) were performed on driven samples obtained from the test borings. The results of these tests are presented in the boring logs. Where applicable, only moisture content was determined from SPT or disturbed samples.

Grain Size Distribution/Fines Content: Representative samples were dried, weighed, and soaked in water until individual soil particles were separated (per ASTM D421) and then washed on a No. 200 sieve (ASTM D1140). Where applicable, the portion retained on the No. 200 sieve was dried and then sieved on a U.S. Standard brass sieve set in accordance with ASTM D6913 (sieve) or ASTM D422 (sieve and hydrometer).

Sample Location	Description	% Passing # 200 Sieve
HS-1 @ 10 ft	Clayey Sand	37
HS-1 @ 20 ft	Sand with Silt	6
HS-1 @ 25 ft	Silty Sand	16
HS-1 @ 30 ft	Clayey Sand with some Gravel	37

Atterberg Limits: The liquid and plastic limits (“Atterberg Limits”) were determined per ASTM D4318 for engineering classification of fine-grained material and presented in the table below. The USCS soil classification indicated in the table below is based on the portion of sample passing the No. 40 sieve and may not necessarily be representative of the entire sample. The plot is provided in this Appendix.

Sample Location	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	USCS Soil Classification
HS-1 @ 15 ft	35	18	17	CL

Laboratory Test Results

Consolidation: One consolidation test was performed per ASTM D2435. A sample (2.4 inches in diameter and 1 inch in height) was placed in a consolidometer and increasing loads were applied. The sample was allowed to consolidate under "double drainage" and total deformation for each loading step was recorded. The percent consolidation for each load step was recorded as the ratio of the amount of vertical compression to the original sample height. The consolidation pressure curve is provided in this Appendix.

Expansion Index: The expansion potential of a selected representative sample was evaluated by the Expansion Index Test per ASTM D4829.

Sample Location	Expansion Index	Expansion Potential*
HS-1 @ 1-5 ft	8	Very Low

* Per ASTM D4829

R-value Test: R-value test was performed in general accordance with California Test Method 301. The plot is included in the Appendix.

Sample Location	R-value
HS-2 @ 1-5 ft	66

Soluble Sulfates: The soluble sulfate content of a selected sample was determined by standard geochemical methods (CTM 417). The test results are presented in the table below.

Sample Location	Sulfate Content (%)
HS-1 @ 1-5 ft	< 0.02

Chloride Content: Chloride content was tested per CTM 422. The results are presented below.

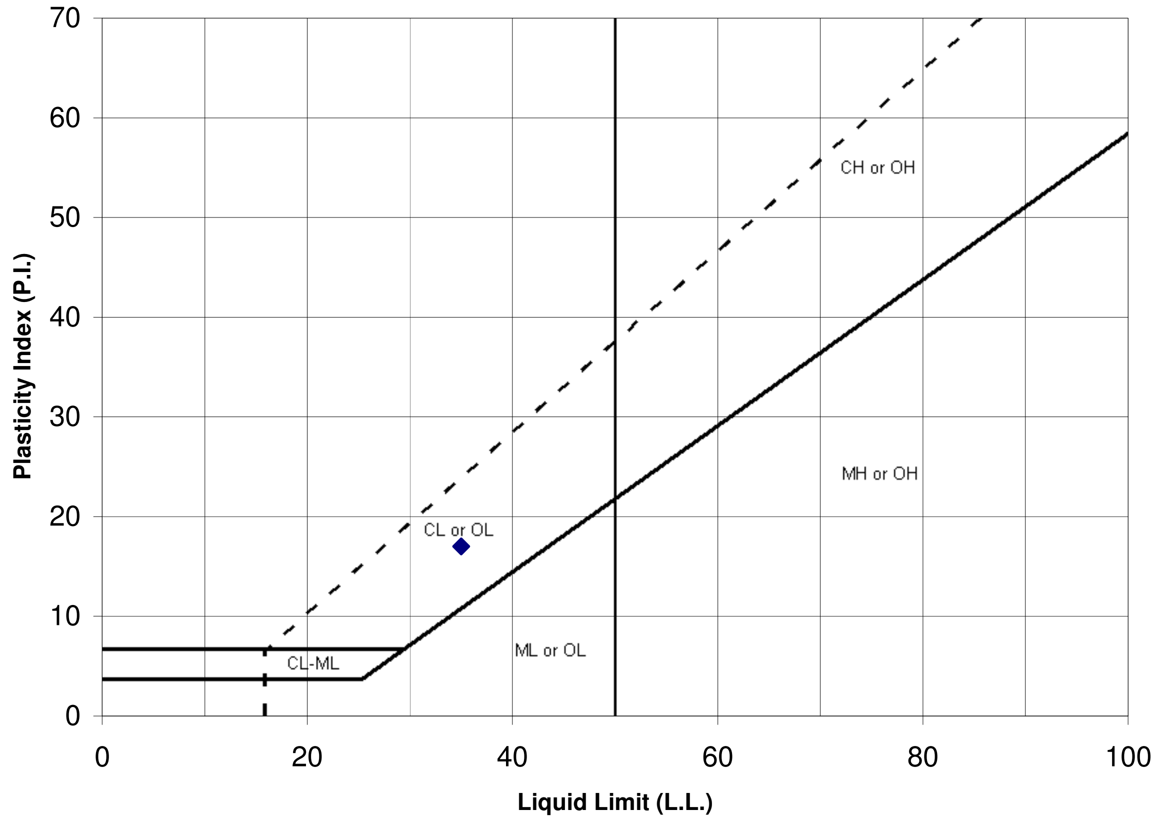
Sample Location	Chloride Content (ppm)
HS-1 @ 1-5 ft	103

Laboratory Test Results

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with CTM 643 and standard geochemical methods. The results are presented in the table below.

Sample Location	**pH**	**Minimum Resistivity (ohms-cm)**
HS-1 @ 1-5 ft	8.2	857

PLASTICITY CHART - CLASSIFICATION OF FINE-GRAINED SOILS



Symbol	Location.:	Sample No.:	Depth (ft)	Passing No. 200 Sieve (%)	Liquid Limit (%) LL	Plastic Limit (%) PL	Plasticity Index (%) PI	USCS
◆	HS-1	SPT-1	15	-	35	18	17	CL

LGC Geotechnical, Inc.

ATTERBERG LIMITS
(ASTM D 4318)

Project Number: 19035-01
Date: Apr-19

Great Scott - Lake Forest

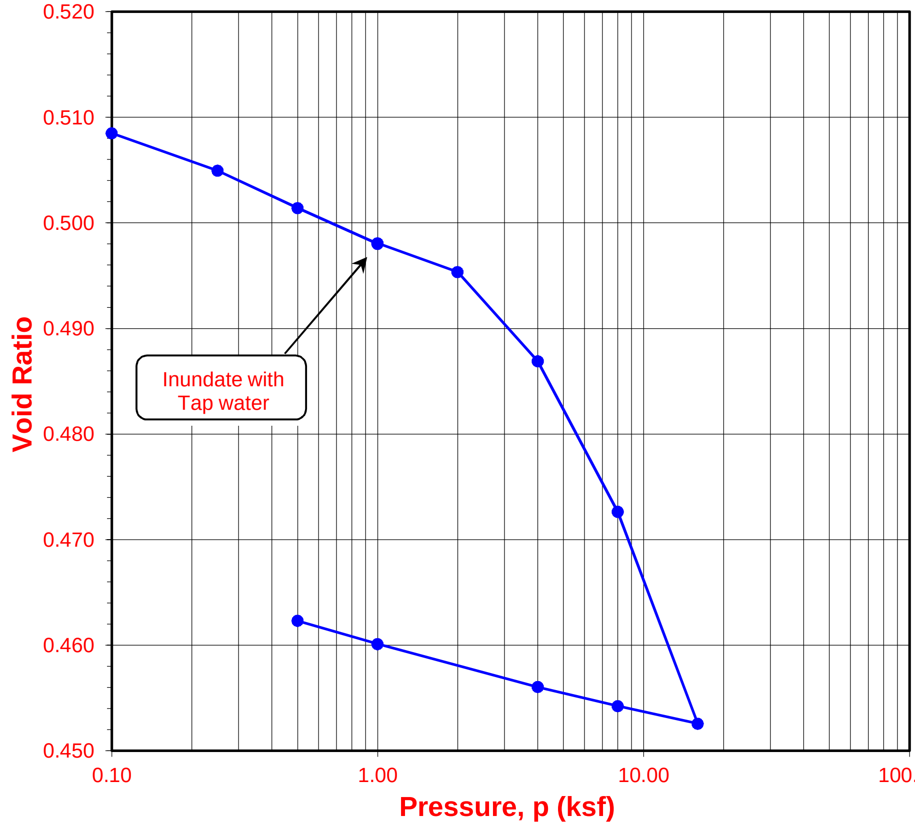
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name: Lake Forest
Project No.: 19035-01
Boring No.: HS-1
Sample No.: R-3
Soil Identification: Dark olive brown clayey sand (SC)

Tested By: G. Bathala Date: 04/10/19
Checked By: J. Ward Date: 04/24/19
Depth (ft.): 7.5
Sample Type: Ring

Sample Diameter (in.)	2.415
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	199.51
Weight of Ring (g)	45.62
Height after consol. (in.)	0.9688
Before Test	
Wt.Wet Sample+Cont. (g)	208.34
Wt.of Dry Sample+Cont. (g)	190.23
Weight of Container (g)	66.23
Initial Moisture Content (%)	14.6
Initial Dry Density (pcf)	111.7
Initial Saturation (%)	77
Initial Vertical Reading (in.)	0.3164
After Test	
Wt.of Wet Sample+Cont. (g)	269.38
Wt. of Dry Sample+Cont. (g)	250.41
Weight of Container (g)	71.40
Final Moisture Content (%)	14.22
Final Dry Density (pcf)	114.5
Final Saturation (%)	81
Final Vertical Reading (in.)	0.2809
Specific Gravity (assumed)	2.70
Water Density (pcf)	62.43

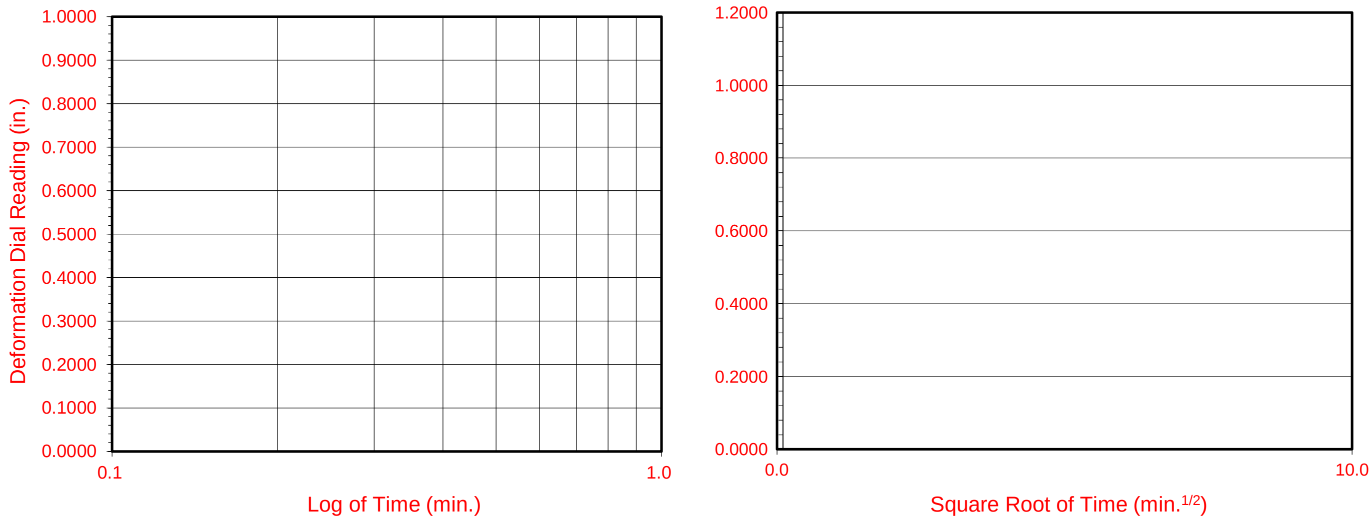


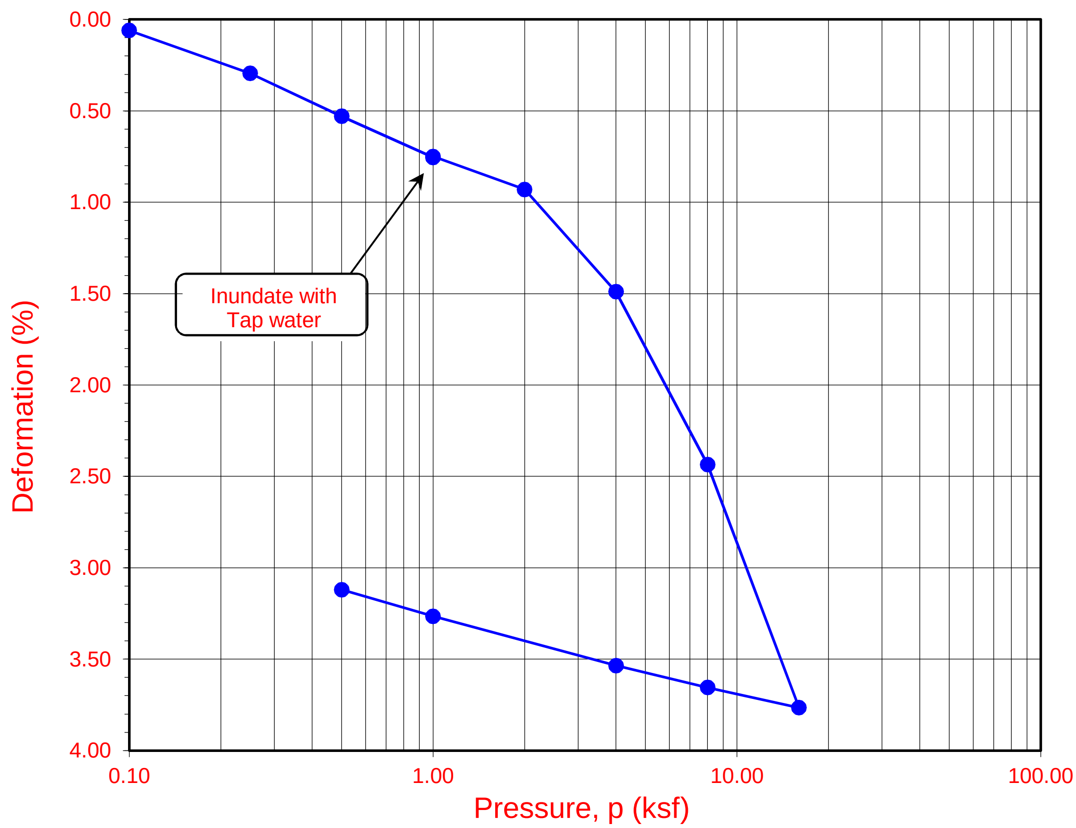
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deforma-tion (%)
0.10	0.3158	0.9994	0.00	0.06	0.508	0.06
0.25	0.3128	0.9964	0.07	0.37	0.505	0.30
0.50	0.3098	0.9934	0.13	0.66	0.501	0.53
1.00	0.3068	0.9904	0.21	0.96	0.498	0.75
1.00	0.3068	0.9904	0.21	0.96	0.498	0.75
2.00	0.3038	0.9874	0.33	1.26	0.495	0.93
4.00	0.2969	0.9805	0.46	1.95	0.487	1.49
8.00	0.2857	0.9693	0.64	3.08	0.473	2.44
16.00	0.2702	0.9538	0.86	4.63	0.453	3.77
8.00	0.2721	0.9557	0.78	4.44	0.454	3.66
4.00	0.2743	0.9579	0.68	4.22	0.456	3.54
1.00	0.2788	0.9624	0.50	3.77	0.460	3.27
0.50	0.2809	0.9645	0.43	3.55	0.462	3.12

Time Readings

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)

Time Readings





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
HS-1	**R-3**	**7.5**	**14.6**	**14.2**	**111.7**	**114.5**	**0.509**	**0.462**	**77**	**81**

Soil Identification: Dark olive brown clayey sand (SC)

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 19035-01

Lake Forest

04-19

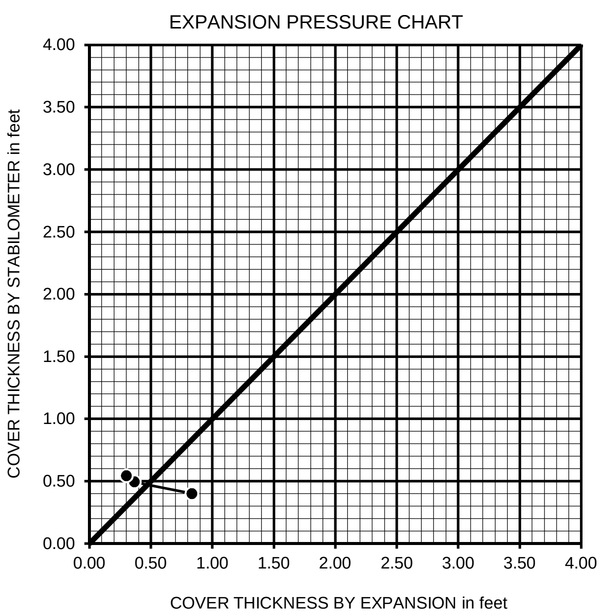
R-VALUE TEST RESULTS

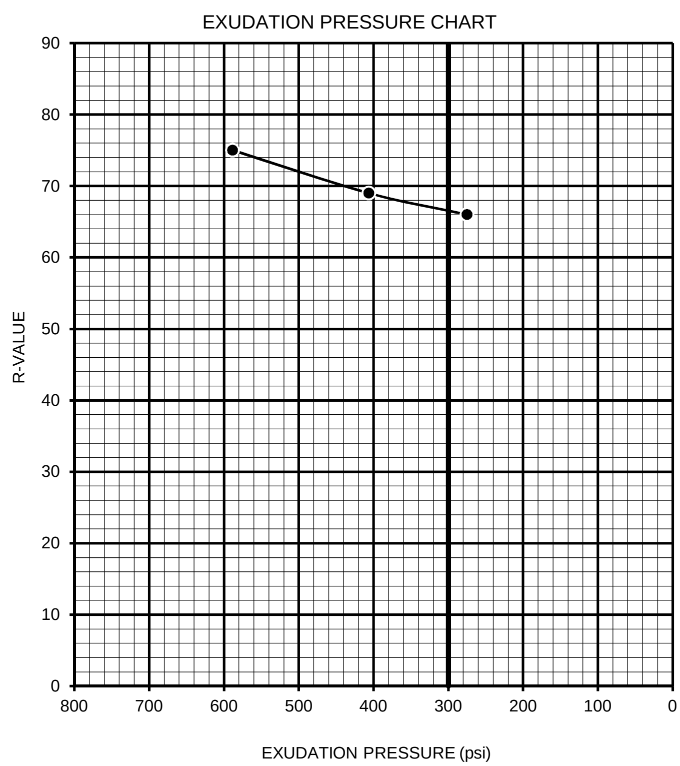
DOT CA Test 301

PROJECT NAME:	Lake Forest	PROJECT NUMBER:	19035-01
BORING NUMBER:	HS-2	DEPTH (FT.):	1-5
SAMPLE NUMBER:	B-1	TECHNICIAN:	S. Felter
SAMPLE DESCRIPTION:	Brown silty sand with Gravel (SM)	DATE COMPLETED:	4/16/2019

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	11.0	11.4	11.8
HEIGHT OF SAMPLE, Inches	2.49	2.50	2.59
DRY DENSITY, pcf	118.4	120.3	116.5
COMPACTOR PRESSURE, psi	350	300	250
EXUDATION PRESSURE, psi	588	406	275
EXPANSION, Inches x 10exp-4	25	11	9
STABILITY Ph 2,000 lbs (160 psi)	26	33	38
TURNS DISPLACEMENT	4.26	4.32	4.42
R-VALUE UNCORRECTED	75	69	64
R-VALUE CORRECTED	75	69	66

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.40	0.50	0.54
EXPANSION PRESSURE THICKNESS, ft.	0.83	0.37	0.30





R-VALUE BY EXPANSION:	70
R-VALUE BY EXUDATION:	66
EQUILIBRIUM R-VALUE:	66

Appendix D
Infiltration Test Data

Infiltration Test Data Sheet

LGC Geotechnical, Inc

131 Calle Iglesia Suite 200, San Clemente, CA 92672 tel. (949) 369-6141

Project Name: Great Scott - Lake Forest
Project Number: 19035-01
Date: 4/4/2019
Boring Number: I-1

Test hole dimensions (if circular)	
Boring Depth (feet)*:	5
Boring Diameter (inches):	8
Pipe Diameter (inches):	2

*measured at time of test

Test pit dimensions (if rectangular)	
Pit Depth (feet):	
Pit Length (feet):	
Pit Breadth (feet):	

Minimum test Head (D_o):

(What the sounder tape should read) Boring Depth - (5 x Boring Radius) 3.4 ft

(Shallow) The value on the sounder tape should be close to this value during testing for **DEEP** testing fill to 4 feet below top of hole

*Pre-Test (Sandy Soil Criteria)**

Trial No.	Start Time (24:HR)	Stop Time (24:HR)	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Greater Than or Equal to 0.5 feet (yes/no)
1	8:37	9:02	25.0	2.54	2.92	0.38	No
2	9:02	9:27	25.0	2.60	2.93	0.33	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight, and then obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25 inches

Main Test Data

Trial No.	Start Time (24:HR)	Stop Time (24:HR)	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (feet)	Calculated Infiltration Rate(in/hr)
1	9:28	9:58	30.0	2.50	2.88	0.38	0.6
2	9:59	10:29	30.0	2.47	2.88	0.41	0.7
3	10:30	11:00	30.0	2.53	2.91	0.38	0.6
4	11:01	11:31	30.0	2.53	2.93	0.4	0.7
5	11:32	12:02	30.0	2.54	2.95	0.41	0.7
6	12:03	12:33	30.0	2.49	2.91	0.42	0.7
7	12:34	13:04	30.0	2.58	3.00	0.42	0.7
8	13:05	13:35	30.0	2.52	2.93	0.41	0.7
9	13:36	14:06	30.0	2.53	2.95	0.42	0.7
10	14:07	14:37	30.0	2.48	2.89	0.41	0.7
11	14:38	15:08	30.0	2.45	2.90	0.45	0.7
12	15:09	15:39	30.0	2.53	2.98	0.45	0.7

Calculated Infiltration Rate (No factors of safety)	**0.7**
Factor of Safety	**2.0**
Calculated Infiltration Rate (With Factor of Safety)	**0.35**

Sketch:

Notes:

Based on Guidelines from: Orange County 05/19/2011

Spreadsheet Revised on: 10/26/2016

LGC Geotechnical, Inc.

Appendix E
Liquefaction Analysis

LIQUEFACTION EVALUATION

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997
and *Evaluation of Settlments in Sand due to Earthquake Shaking*, Tokimatsu and Seed, 1987

Seismic Event		**Profile Constants**		**Depth to GWT**		**Project Name**	Great Scott M.V.
Moment Magnitude	6.9	Total Unit Weight (lb/ft^3)	120	During Investigation (ft)	15	**Project Number**	19035-01
Peak Ground Acceleration	0.53 g	Unit Weight of Water (lbs/ft	62.4	During Design Event (ft)	10	**Boring**	HS- 1

Determination of Cyclic Resitance Ratio

Sampling Data					During Investigation			Sampling Correction Factors											
		Blow Count		Thickness	Total Stress	Pore Pressure	Effective	Sampler	SPT	Overburden	Energy	Borehole	Rod Length	Sampler Type		Fines			
Depth (ft)	Depth (m)	SPT	Rings	(ft)	Stress (psf)	Pressure (psf)	Stress (psf)	Diameter	N_m	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Content	$\mathbf{(N_1)_{60cs}}$	K_σ	$CRR_{7.5}$
2.5	0.8		12	3.75	420	0	420	0.62	7.44	1.70	1.25	1.00	0.75	1.00	11.86	5	11.9	1.000	0.128
5	1.5		6	2.5	720	0	720	0.62	3.72	1.70	1.25	1.00	0.75	1.00	5.94	25	10.9	1.000	0.118
7.5	2.3		11	3.75	1020	0	1020	0.62	6.82	1.43	1.25	1.00	0.75	1.00	9.15	25	14.5	1.000	0.157
10	3.0		5	2.5	1320	0	1320	0.62	3.10	1.26	1.25	1.00	0.75	1.00	3.66	37	9.4	1.000	0.102
15	4.6	5		5	1920	0	1920	1.00	5.00	1.04	1.25	1.00	0.85	1.10	6.09	50	12.3	1.000	0.133
20	6.1		23	5	2520	312	2208	0.62	14.26	0.97	1.25	1.00	0.95	1.00	16.47	6	16.6	0.986	0.176
25	7.6	23		5	3120	624	2496	1.00	23.00	0.91	1.25	1.00	0.95	1.10	27.48	16	31.7	0.965	SPT >30 NF
30	9.1		33	5	3720	936	2784	0.62	20.46	0.87	1.25	1.00	0.95	1.00	21.04	37	30.2	0.946	SPT >30 NF
35	10.7	38		5	4320	1248	3072	1.00	38.00	0.82	1.25	1.00	1.00	1.10	43.08	15	47.6	0.927	SPT >30 NF
40	12.2		100	5	4920	1560	3360	0.62	62.00	0.79	1.25	1.00	1.00	1.00	61.09	15	66.5	0.910	SPT >30 NF
45	13.7	100		2.5	5520	1872	3648	1.00	100.00	0.76	1.25	1.00	1.00	1.10	104.03	15	111.5	0.893	SPT >30 NF

Determination of Cyclic Stress Ratio

Sampling Data					During Design Event						
		Blow Count			Total Stress	Pore Pressure	Effective				
Depth (ft)	Depth (m)	SPT	Rings	Thickness	Stress (psf)	Pressure (psf)	Stress (psf)	r_d	CSR	MSF	FS
2.5	0.76		12	3.75	300	0	300	0.99615	0.343174	1.238	Above GWT
5	1.52		6	2.5	600	0	600	0.99024	0.341136	1.238	Above GWT
7.5	2.29		11	3.75	900	0	900	0.98456	0.339181	1.238	Above GWT
10	3.05		5	2.5	1200	0	1200	0.97914	0.337314	1.238	0.37
15	4.57	5		5	1800	312	1488	0.96856	0.403631	1.238	Bray-Clay
20	6.10		23	5	2400	624	1776	0.9569	0.445474	1.238	0.49
25	7.62	23		5	3000	936	2064	0.94183	0.471601	1.238	Corr. SPT>30
30	9.14		33	5	3600	1248	2352	0.92058	0.485417	1.238	Corr. SPT>30
35	10.67	38		5	4200	1560	2640	0.89062	0.488119	1.238	Corr. SPT>30
40	12.19		100	5	4800	1872	2928	0.85103	0.480625	1.238	Corr. SPT>30
45	13.72	100		2.5	5400	2184	3216	0.80363	0.464861	1.238	Corr. SPT>30

Appendix F
General Earthwork and Grading Specifications for Rough Grading

General Earthwork and Grading Specifications for Rough Grading

1.0 ***General***

1.1 ***Intent:*** These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 ***The Geotechnical Consultant of Record:*** Prior to commencement of work, the owner shall employ a qualified Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to confirm that the attained level of compaction is being accomplished as specified. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 ***The Earthwork Contractor:*** The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the project plans and specifications. The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of “equipment” of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the

Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified. It is the contractor's sole responsibility to provide proper fill compaction.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing: Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed. The contractor is responsible for all hazardous waste relating to his work. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Client should acquire the services of a qualified environmental assessor.

2.2 Processing: Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of oversize material and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 ***Overexcavation*:** In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 ***Benching*:** Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 ***Evaluation/Acceptance of Fill Areas*:** All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 ***General*:** Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 ***Oversize*:** Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 ***Import*:** If importing of fill material is required for grading, proposed import material shall meet the requirements of the geotechnical consultant. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 ***Fill Layers:*** Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 ***Fill Moisture Conditioning:*** Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557).

4.3 ***Compaction of Fill:*** After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 ***Compaction of Fill Slopes:*** In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.5 ***Compaction Testing:*** Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 ***Frequency of Compaction Testing:*** Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 ***Compaction Test Locations:*** The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

7.2 All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

7.3 The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

7.4 The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.5 Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Orange County and Part of Riverside County, California

December 6, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:2,460 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 13, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 3, 2015—Jan 17, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
142	Cieneba sandy loam, 30 to 75 percent slopes, eroded	0.3	3.9%
176	Myford sandy loam, 15 to 30 percent slopes	0.1	1.1%
191	Riverwash	4.6	57.3%
207	Sorrento loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	3.0	37.7%
Totals for Area of Interest		**8.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Orange County and Part of Riverside County, California

142—Cieneba sandy loam, 30 to 75 percent slopes, eroded

Map Unit Setting

National map unit symbol: hcml
Elevation: 500 to 4,000 feet
Mean annual precipitation: 12 to 35 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 200 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Cieneba and similar soils: 65 percent
Minor components: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cieneba

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave, convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite

Typical profile

H1 - 0 to 7 inches: sandy loam
H2 - 7 to 59 inches: weathered bedrock

Properties and qualities

Slope: 30 to 75 percent
Depth to restrictive feature: 4 to 20 inches to paralithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: SHALLOW LOAMY (1975) (R019XD060CA)
Hydric soil rating: No

Minor Components

Cieneba, uneroded

Percent of map unit: 10 percent
Hydric soil rating: No

Vista, sandy loam
Percent of map unit: 5 percent
Hydric soil rating: No

San andreas, sandy loam
Percent of map unit: 5 percent
Hydric soil rating: No

Soper, cobbly loam
Percent of map unit: 5 percent
Hydric soil rating: No

Calleguas, clay loam
Percent of map unit: 5 percent
Hydric soil rating: No

Tollhouse
Percent of map unit: 2 percent
Hydric soil rating: No

Rock outcrop
Percent of map unit: 2 percent
Hydric soil rating: No

Blasingame, loam
Percent of map unit: 1 percent
Hydric soil rating: No

176—Myford sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hcnp
Elevation: 1,500 feet
Mean annual precipitation: 12 to 20 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 270 to 350 days
Farmland classification: Not prime farmland

Map Unit Composition

Myford and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Myford

Setting

Landform: Terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from mixed

Typical profile

H1 - 0 to 12 inches: sandy loam
H2 - 12 to 18 inches: sandy clay
H3 - 18 to 28 inches: sandy clay loam
H4 - 28 to 71 inches: sandy clay loam
H5 - 71 to 79 inches: sandy loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: About 12 inches to abrupt textural change
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: CLAYPAN (1975) (R019XD061CA)
Hydric soil rating: No

Minor Components

Myford, sandy loam, eroded

Percent of map unit: 5 percent
Hydric soil rating: No

Myford, less sloping or steeper

Percent of map unit: 5 percent
Hydric soil rating: No

Cieneba, sandy loam

Percent of map unit: 3 percent
Hydric soil rating: No

Yorba, gravelly sandy loam

Percent of map unit: 2 percent
Hydric soil rating: No

191—Riverwash

Map Unit Composition

Riverwash: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverwash

Setting

Landform: Fans
Parent material: Sandy and gravelly alluvium

Typical profile

C1 - 0 to 6 inches: gravelly sand
C2 - 6 to 60 inches: stratified gravelly coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Frequent
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydric soil rating: Yes

207—Sorrento loam, 2 to 9 percent slopes, warm MAAT, MLRA 19

Map Unit Setting

National map unit symbol: 2tz0c
Elevation: 0 to 1,340 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 62 to 66 degrees F
Frost-free period: 320 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sorrento and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sorrento

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

A - 0 to 12 inches: loam
AB - 12 to 37 inches: silty clay loam
Bk - 37 to 62 inches: silty clay loam

2C - 62 to 72 inches: sandy loam

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: LOAMY (1975) (R019XD029CA)
Hydric soil rating: No

Minor Components

Mocho

Percent of map unit: 7 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Botella

Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: LOAMY (1975) (R019XD029CA)
Hydric soil rating: No

Pico

Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Garretson

Percent of map unit: 2 percent
Landform: Alluvial fans

Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Anacapa

Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

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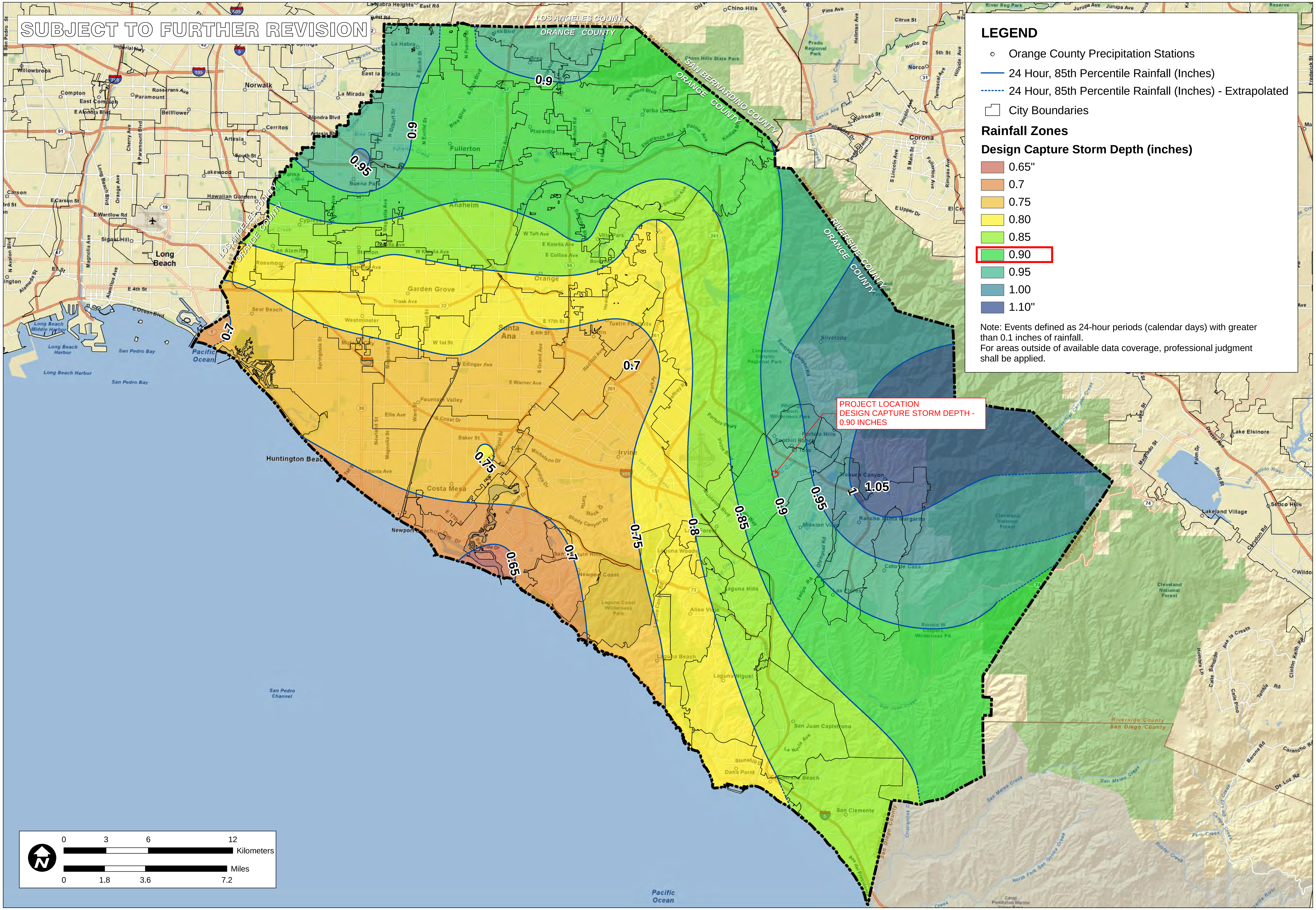
Appendix D

BMP Design Details



TITLE

RAINFALL ZONES

JOB

ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT

ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

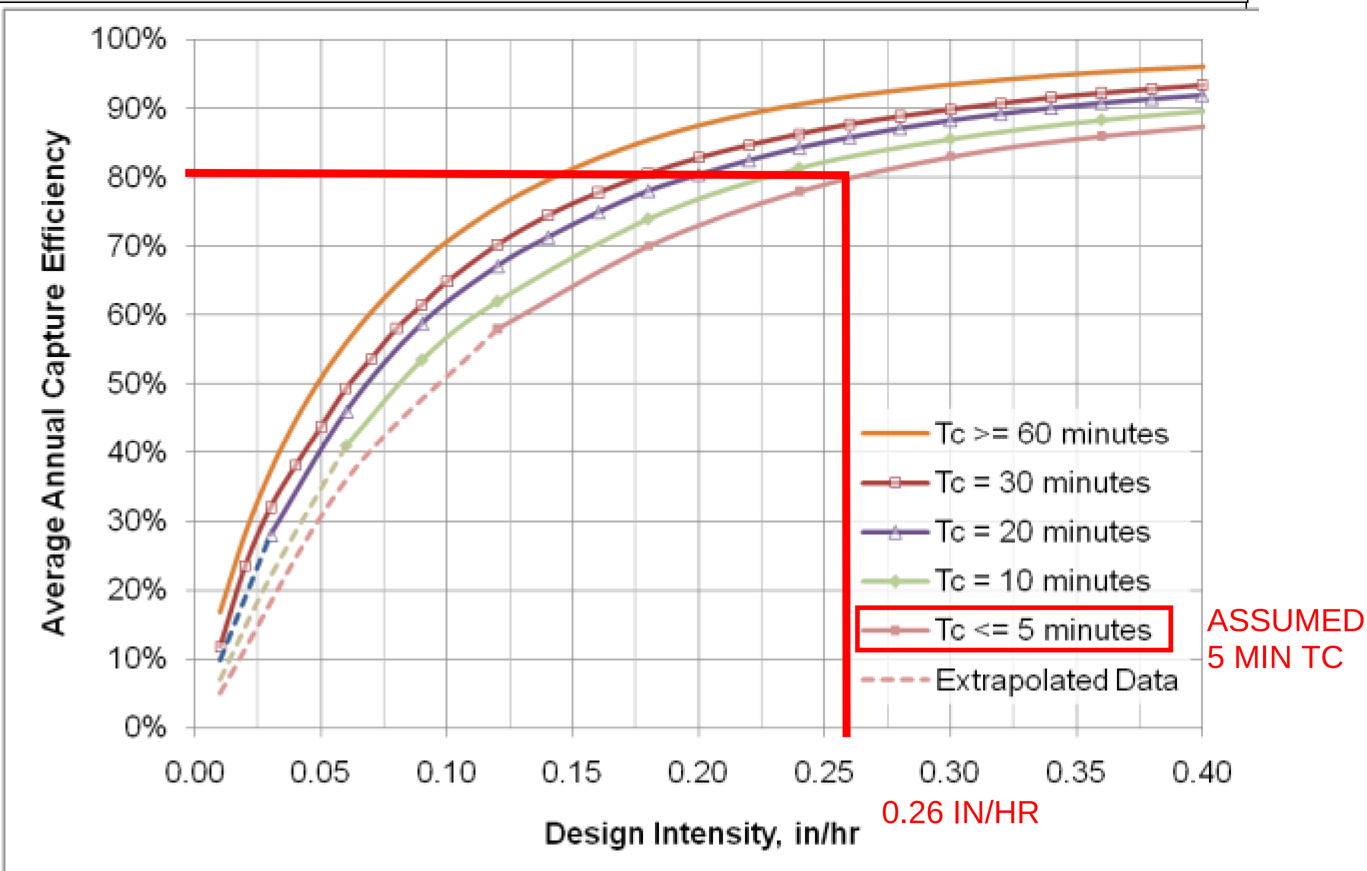
PACE Advanced Water Engineering

FIGURE

XVI-1

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd

Worksheet F: Determining Capture Efficiency of a Flow-based BMP based on Treatment Capacity

Graphical Operations

Provide supporting graphical operations.

Impervious Fraction Calculations

DMA A				
Land Use	Area (sf)	Area (ac)	Imp. Fraction	Weight
Landscape	7,385	0.170	0.2	0.03
Pavement	6,331	0.145	0.9	0.13
Gravel	4,702	0.108	0.9	0.10
Bioswale	1,267	0.029	0.1	0.00
Basin	-	0.000	0.2	0.00
Building	-	0.000	0.9	0.00
TOTAL AREA	19,685	0.452		
Weighted Imp. Fraction				0.59

DMA B				
Land Use	Area (sf)	Area (ac)	Imp. Fraction	Weight
Landscape	16,263	0.373	0.2	0.07
Pavement/Walkway	7,622	0.175	0.9	0.16
Gravel	36,102	0.829	0.9	0.75
Bioswale	1,843	0.042	0.1	0.00
Basin	-	0.000	0.2	0.00
Building	8,302	0.191	0.9	0.17
TOTAL AREA	70,132	1.610		
Weighted Imp. Fraction				0.72

DMA C				
Land Use	Area (sf)	Area (ac)	Imp. Fraction	Weight
Landscape	18,024	0.414	0.2	0.08
Pavement	689	0.016	0.9	0.01
Gravel	-	0.000	0.9	0.00
Bioswale	1,481	0.034	0.1	0.00
Basin	8,991	0.206	0.2	0.04
Building	-	0.000	0.9	0.00
TOTAL AREA	29,185	0.670		
Weighted Imp. Fraction				0.21

Design Capture Volume and Flow Rate			
V=C x d x A x 43560 sf/ac x 1/12 in/ft			
C = 0.75 x imp + 0.15			
Q = C x i x A			
	DMA		
	A	**B**	**C**
Design Capture Storm Depth	0.9	0.9	0.9
Drainage Area (SF)	19,685	70,132	29,185
Impervious Area (SF)	11,533	50,260	6,172
Pervious Area (SF)	8,152	19,871	23,014
% Impervious	0.59	0.72	0.21
Eff. Ret. Depth of HSC (in)	0.00	0.00	0.00
Design Infiltration Rate (in/hr)	0.00	0.00	0.00
Design Capture Volume (CF)	**870**	**3,616**	**675**
i (design intensity) (inches/hr)	0.26	0.26	0.26
Design Treatment Flow Rate (CFS)	**0.07**	**0.29**	**0.05**

Vegetated Swale (per OC TGD BIO-2)			
	DMA		
	A	**B**	**C**
swale slope (ft/ft)	0.0400	0.0100	0.0100
bottom width, calculated (ft)	0.30	2.46	0.46
bottom width used (2 ft min) (ft)	3.00	5.00	5.00
y, depth (ft)	0.08	0.22	0.08
Vwq	0.27	0.25	0.13
Required Length, ft	160	148	80
Length Provided, ft	177	200	140

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2014 Advanced Engineering Software (aes)
             Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                           Analysis prepared by:

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                      2603 Main Street, Irvine CA. 92614
                                Suite 400
                               949-988-5815


 ************************** DESCRIPTION OF STUDY **************************
* Great Scott - Lake Forest Existing Hydrology                              *
* Rational Method 2-year storm event                                        *
* Ryan Kim 2/11/2020 Revised by ATS 10/07/2020, VAA 06/15/2021              *
 **************************************************************************

  FILE NAME: GS2E.DAT
  TIME/DATE OF STUDY: 15:44 06/15/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *PIPE MAY BE SIZED TO HAVE A FLOW CAPACITY LESS THAN
   UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   164.30
  ELEVATION DATA: UPSTREAM(FEET) =    650.00  DOWNSTREAM(FEET) =    631.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.364
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.685
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "OPEN BRUSH"               D        0.32      0.20     1.000    67    8.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.42
  TOTAL AREA(ACRES) =      0.32   PEAK FLOW RATE(CFS) =      0.42

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    105.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    631.00  DOWNSTREAM(FEET) =    629.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.60   CHANNEL SLOPE =  0.0360
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.42
  FLOW VELOCITY(FEET/SEC) =   2.84 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.33   Tc(MIN.) =    8.69
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    105.00 =     219.90 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   248.60
  ELEVATION DATA: UPSTREAM(FEET) =    645.00  DOWNSTREAM(FEET) =    638.00
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.215
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.834
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.41      0.20     0.500    57    7.21
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA RUNOFF(CFS) =      0.64
  TOTAL AREA(ACRES) =      0.41   PEAK FLOW RATE(CFS) =      0.64

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    638.00  DOWNSTREAM(FEET) =    630.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   226.50   CHANNEL SLOPE =  0.0353
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.64
  FLOW VELOCITY(FEET/SEC) =   2.82 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.34   Tc(MIN.) =    8.55
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     475.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.55
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.663
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.37      0.20     0.500    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA AREA(ACRES) =    0.37      SUBAREA RUNOFF(CFS) =    0.52
  EFFECTIVE AREA(ACRES) =      0.78   AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.50
  TOTAL AREA(ACRES) =        0.8       PEAK FLOW RATE(CFS) =       1.10

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    503.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
```

```
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    630.00  DOWNSTREAM(FEET) =    610.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   285.20   CHANNEL SLOPE =  0.0701
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.10
  FLOW VELOCITY(FEET/SEC) =   4.04 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.18   Tc(MIN.) =    9.73
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.73
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.545
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "1 DWELLING/ACRE"           D        0.23      0.20     0.800    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.29
  EFFECTIVE AREA(ACRES) =      1.02   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.57
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =       1.31

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.31    9.73    1.545  0.20( 0.11) 0.57       1.0     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.42    8.69    1.648  0.20( 0.20) 1.00       0.3     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    503.00 =     219.90 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.68    8.69    1.648  0.20( 0.14) 0.68       1.2     400.00
```

```
    2       1.70    9.73    1.545  0.20( 0.13) 0.67       1.3     500.00
   TOTAL AREA(ACRES) =        1.3

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       1.70  Tc(MIN.) =    9.730
 EFFECTIVE AREA(ACRES) =      1.33  AREA-AVERAGED Fm(INCH/HR) =  0.13
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.68
 TOTAL AREA(ACRES) =        1.3
 LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     760.30 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    503.00 TO NODE    603.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    610.00  DOWNSTREAM(FEET) =    608.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =    76.20   CHANNEL SLOPE =  0.0262
 CHANNEL FLOW THRU SUBAREA(CFS) =       1.70
 FLOW VELOCITY(FEET/SEC) =   2.70 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   0.47   Tc(MIN.) =   10.20
 LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   297.60
 ELEVATION DATA: UPSTREAM(FEET) =    643.00  DOWNSTREAM(FEET) =    635.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.242
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.830
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  CONDOMINIUMS               D        0.50      0.20     0.350    57    7.24
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      0.80
  TOTAL AREA(ACRES) =      0.50   PEAK FLOW RATE(CFS) =      0.80

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    635.00  DOWNSTREAM(FEET) =    630.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   225.00   CHANNEL SLOPE =  0.0222
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.80
  FLOW VELOCITY(FEET/SEC) =   2.24 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.68   Tc(MIN.) =    8.92
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    602.00 =     522.60 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    602.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.92
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.624
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       D        0.50      0.20     0.500    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA AREA(ACRES) =    0.50      SUBAREA RUNOFF(CFS) =    0.69
  EFFECTIVE AREA(ACRES) =      1.00   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.42
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =       1.39

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    603.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    630.00  DOWNSTREAM(FEET) =    608.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   279.50   CHANNEL SLOPE =  0.0787
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.39
  FLOW VELOCITY(FEET/SEC) =   4.48 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.04   Tc(MIN.) =    9.96
```

```
 LONGEST FLOWPATH FROM NODE    600.00 TO NODE    603.00 =     802.10 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    9.96
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.524
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 ".4 DWELLING/ACRE"         D        0.47      0.20     0.900    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
 SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    0.56
 EFFECTIVE AREA(ACRES) =      1.47   AREA-AVERAGED Fm(INCH/HR) =  0.12
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.58
 TOTAL AREA(ACRES) =        1.5       PEAK FLOW RATE(CFS) =       1.86

****************************************************************************
 FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        1.86    9.96    1.524  0.20( 0.12) 0.58       1.5     600.00
 LONGEST FLOWPATH FROM NODE    600.00 TO NODE    603.00 =     802.10 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        1.68    9.16    1.599  0.20( 0.14) 0.68       1.2     400.00
     2        1.70   10.20    1.503  0.20( 0.13) 0.67       1.3     500.00
 LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        3.48    9.16    1.599  0.20( 0.13) 0.63       2.6     400.00
     2        3.56    9.96    1.524  0.20( 0.12) 0.62       2.8     600.00
     3        3.54   10.20    1.503  0.20( 0.12) 0.62       2.8     500.00
   TOTAL AREA(ACRES) =        2.8

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        3.56  Tc(MIN.) =    9.958
```

```
  EFFECTIVE AREA(ACRES) =      2.78  AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.63
  TOTAL AREA(ACRES) =        2.8
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    603.00 =     836.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    603.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    704.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    608.00  DOWNSTREAM(FEET) =    600.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   260.10   CHANNEL SLOPE =  0.0308
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.56
  FLOW VELOCITY(FEET/SEC) =   3.42 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.27   Tc(MIN.) =   11.23
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    704.00 =    1096.60 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    704.00 TO NODE    704.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.23
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.423
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        0.29      0.20     0.900    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA AREA(ACRES) =    0.29      SUBAREA RUNOFF(CFS) =    0.33
  EFFECTIVE AREA(ACRES) =      3.07   AREA-AVERAGED Fm(INCH/HR) =  0.13
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.65
  TOTAL AREA(ACRES) =        3.1       PEAK FLOW RATE(CFS) =       3.57
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.1  TC(MIN.) =     11.23
  EFFECTIVE AREA(ACRES) =      3.07  AREA-AVERAGED Fm(INCH/HR)=  0.13
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.648
  PEAK FLOW RATE(CFS)   =       3.57

  ** PEAK FLOW RATE TABLE **
```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	3.49	10.44	1.484	0.20(0.13)	0.65	2.9	400.00
2	3.57	11.23	1.423	0.20(0.13)	0.65	3.1	600.00
3	3.55	11.47	1.406	0.20(0.13)	0.65	3.1	500.00

==
==

END OF RATIONAL METHOD ANALYSIS

```
****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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             Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                           Analysis prepared by:

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                                 Suite 400
                               949-988-5815


 ************************** DESCRIPTION OF STUDY **************************
* Great Scott - Lake Forest Proposed Hydrology                             *
* Rational Method 2-year storm event                                       *
* Ryan Kim 2/11/2020 Revised by ATS 10/07/2020, VAA 06/15/2021             *
 **************************************************************************

  FILE NAME: GS2P.DAT
  TIME/DATE OF STUDY: 08:32 06/16/2021
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *PIPE MAY BE SIZED TO HAVE A FLOW CAPACITY LESS THAN
   UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   238.00
  ELEVATION DATA: UPSTREAM(FEET) =    654.00  DOWNSTREAM(FEET) =    644.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.878
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.378
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "OPEN BRUSH"               D        0.24      0.20     1.000    67   11.88
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.25
  TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      0.25

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    644.00  DOWNSTREAM(FEET) =    641.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   119.00   CHANNEL SLOPE =  0.0252
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.25
  FLOW VELOCITY(FEET/SEC) =   2.38 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =   12.71
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    402.00 =     357.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.71
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.325
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.18      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.18      SUBAREA RUNOFF(CFS) =    0.21
  EFFECTIVE AREA(ACRES) =      0.42   AREA-AVERAGED Fm(INCH/HR) =  0.12
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.62
  TOTAL AREA(ACRES) =        0.4       PEAK FLOW RATE(CFS) =       0.45

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    403.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    641.00  DOWNSTREAM(FEET) =    634.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   176.00   CHANNEL SLOPE =  0.0398
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.237
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D        0.04      0.20     0.850    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.47
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.82
  AVERAGE FLOW DEPTH(FEET) =   0.08   TRAVEL TIME(MIN.) =   1.61
  Tc(MIN.) =   14.32
  SUBAREA AREA(ACRES) =     0.04       SUBAREA RUNOFF(CFS) =    0.04
  EFFECTIVE AREA(ACRES) =      0.45     AREA-AVERAGED Fm(INCH/HR) =   0.13
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.64
  TOTAL AREA(ACRES) =        0.5         PEAK FLOW RATE(CFS) =       0.45

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.08   FLOW VELOCITY(FEET/SEC.) =   1.76
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    403.00 =     533.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    404.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   631.00  DOWNSTREAM(FEET) =   627.00
  FLOW LENGTH(FEET) =   342.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.39
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.45
  PIPE TRAVEL TIME(MIN.) =   1.68    Tc(MIN.) =   16.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    404.00 =     875.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    404.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    627.00  DOWNSTREAM(FEET) =    615.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.4000
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.45
  FLOW VELOCITY(FEET/SEC) =   4.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.11   Tc(MIN.) =   16.11
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    84.00
  ELEVATION DATA: UPSTREAM(FEET) =    642.00  DOWNSTREAM(FEET) =    638.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D       0.13      0.20     0.100    57    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.25
  TOTAL AREA(ACRES) =      0.13   PEAK FLOW RATE(CFS) =      0.25

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    638.00  DOWNSTREAM(FEET) =    636.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    98.00   CHANNEL SLOPE =  0.0173
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
```

```
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.25
  FLOW VELOCITY(FEET/SEC) =   1.98 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =    5.83
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     182.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    5.83
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.073
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.20      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.20      SUBAREA RUNOFF(CFS) =    0.38
  EFFECTIVE AREA(ACRES) =      0.33   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        0.3       PEAK FLOW RATE(CFS) =       0.61

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    503.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    636.30  DOWNSTREAM(FEET) =    627.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   180.00   CHANNEL SLOPE =  0.0489
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.61
  FLOW VELOCITY(FEET/SEC) =   3.32 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.90   Tc(MIN.) =    6.73
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =     362.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    503.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    6.73
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.909
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.55      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
```

```
  SUBAREA AREA(ACRES) =    0.55      SUBAREA RUNOFF(CFS) =    0.93
  EFFECTIVE AREA(ACRES) =      0.88   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        0.9       PEAK FLOW RATE(CFS) =       1.49

****************************************************************************
  FLOW PROCESS FROM NODE    503.00 TO NODE    504.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    627.50  DOWNSTREAM(FEET) =    626.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0075
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.49
  FLOW VELOCITY(FEET/SEC) =   1.40 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.37   Tc(MIN.) =    9.11
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    504.00 =     562.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    504.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.11
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.605
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D       0.68      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.68      SUBAREA RUNOFF(CFS) =    0.97
  EFFECTIVE AREA(ACRES) =      1.56   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       2.22

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    504.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.11
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.605
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D       0.05      0.20     0.850    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.05      SUBAREA RUNOFF(CFS) =    0.07
```

```
  EFFECTIVE AREA(ACRES) =      1.61   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.12
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       2.29

****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    505.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   623.00  DOWNSTREAM(FEET) =   622.00
  FLOW LENGTH(FEET) =    32.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.74
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.29
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    9.18
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    505.00 =     594.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    505.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    622.50  DOWNSTREAM(FEET) =    615.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.2500
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       2.29
  FLOW VELOCITY(FEET/SEC) =   5.60 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.09   Tc(MIN.) =    9.26
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    600.00 =     624.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.29    9.26    1.589  0.20( 0.02) 0.12       1.6     500.00
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    600.00 =     624.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.45   16.11    1.157  0.20( 0.13) 0.64       0.5     400.00
```

```
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.66    9.26    1.589  0.20( 0.04) 0.20       1.9     500.00
      2        2.11   16.11    1.157  0.20( 0.05) 0.24       2.1     400.00
    TOTAL AREA(ACRES) =         2.1

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        2.66  Tc(MIN.) =    9.264
  EFFECTIVE AREA(ACRES) =      1.87  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.1
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    506.00 TO NODE    507.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    93.00
  ELEVATION DATA: UPSTREAM(FEET) =    624.60  DOWNSTREAM(FEET) =    623.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.191
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.838
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D       0.24      0.20     0.850    57    7.19
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      0.36
  TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      0.36

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    507.00 TO NODE    508.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    623.50  DOWNSTREAM(FEET) =    621.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   143.00   CHANNEL SLOPE =  0.0140
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.562
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D       0.04      0.20     0.850    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.38
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.01
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   2.35
  Tc(MIN.) =    9.54
  SUBAREA AREA(ACRES) =     0.04       SUBAREA RUNOFF(CFS) =    0.05
  EFFECTIVE AREA(ACRES) =      0.28     AREA-AVERAGED Fm(INCH/HR) =   0.17
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       0.36
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.07   FLOW VELOCITY(FEET/SEC.) =   0.98
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    508.00 =     236.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    508.00 TO NODE    509.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   618.50  DOWNSTREAM(FEET) =   617.50
  FLOW LENGTH(FEET) =   158.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.53
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.36
  PIPE TRAVEL TIME(MIN.) =   1.04    Tc(MIN.) =   10.58
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    509.00 =     394.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    509.00 TO NODE    600.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
```

```
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    617.50  DOWNSTREAM(FEET) =    615.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    72.00   CHANNEL SLOPE =  0.0347
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.36
  FLOW VELOCITY(FEET/SEC) =   2.80 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.43   Tc(MIN.) =   11.01
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    600.00 =     466.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  81
------------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =   11.01
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.439
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                D       0.39      0.20     0.850    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.39      SUBAREA RUNOFF(CFS) =    0.45
  EFFECTIVE AREA(ACRES) =      0.67   AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.85
  TOTAL AREA(ACRES) =        0.7       PEAK FLOW RATE(CFS) =       0.76

******************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  11
------------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
==============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.76   11.01    1.439  0.20( 0.17) 0.85       0.7     506.00
  LONGEST FLOWPATH FROM NODE    506.00 TO NODE    600.00 =     466.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.66    9.26    1.589  0.20( 0.04) 0.20       1.9     500.00
      2        2.11   16.11    1.157  0.20( 0.05) 0.24       2.1     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
```

```
     1        3.38    9.26    1.589  0.20( 0.07) 0.35       2.4     500.00
     2        3.28   11.01    1.439  0.20( 0.07) 0.37       2.6     506.00
     3        2.70   16.11    1.157  0.20( 0.08) 0.39       2.7     400.00
   TOTAL AREA(ACRES) =         2.7

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        3.38  Tc(MIN.) =    9.264
  EFFECTIVE AREA(ACRES) =      2.43  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =        2.7
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    600.00 =     905.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   613.00  DOWNSTREAM(FEET) =   612.50
  FLOW LENGTH(FEET) =    95.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.55
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.38
  PIPE TRAVEL TIME(MIN.) =   0.35    Tc(MIN.) =    9.61
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    601.00 =    1000.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    612.50  DOWNSTREAM(FEET) =    600.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   462.00   CHANNEL SLOPE =  0.0271
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.38
  FLOW VELOCITY(FEET/SEC) =   3.17 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.43   Tc(MIN.) =   12.04
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    602.00 =    1462.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =         2.7  TC(MIN.) =     12.04
  EFFECTIVE AREA(ACRES) =      2.43  AREA-AVERAGED Fm(INCH/HR)=  0.07
```

AREA-AVERAGED Fp(INCH/HR) = 0.20 AREA-AVERAGED Ap = 0.347
PEAK FLOW RATE(CFS) = 3.38

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	3.38	12.04	1.367	0.20(0.07)	0.35	2.4	500.00
2	3.28	13.81	1.264	0.20(0.07)	0.37	2.6	506.00
3	2.70	19.03	1.051	0.20(0.08)	0.39	2.7	400.00

==
==

END OF RATIONAL METHOD ANALYSIS

```
****************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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                           Analysis prepared by:

                              Huitt-Zollars, Inc.
                      2603 Main Street, Irvine CA. 92614
                                Suite 400
                               949-988-5815


****************************************************************************
----------------------------------------------------------------------------


 Problem Descriptions:
  GREAT SCOTT
  UNIT HYDROGRAPH - EXISTING CONDITION
  2 YR AMC I V.AGUIRRE 6/16/2021
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =     3.09
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.148
    LOW LOSS FRACTION = 0.756
    TIME OF CONCENTRATION(MIN.) = 11.23
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =    2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =      0.18
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =      0.35

****************************************************************************
  TIME      VOLUME       Q     0.         2.5        5.0        7.5       10.0
 (HOURS)     (AF)      (CFS)
----------------------------------------------------------------------------
  0.09      0.0001      0.02  Q          .          .          .          .
```

0.28	0.0004	0.02	Q	.	.	.	.
0.47	0.0008	0.02	Q	.	.	.	.
0.65	0.0011	0.02	Q	.	.	.	.
0.84	0.0014	0.02	Q	.	.	.	.
1.03	0.0018	0.02	Q	.	.	.	.
1.21	0.0021	0.02	Q	.	.	.	.
1.40	0.0025	0.02	Q	.	.	.	.
1.59	0.0028	0.02	Q	.	.	.	.
1.78	0.0032	0.02	Q	.	.	.	.
1.96	0.0036	0.02	Q	.	.	.	.
2.15	0.0039	0.02	Q	.	.	.	.
2.34	0.0043	0.02	Q	.	.	.	.
2.52	0.0047	0.02	Q	.	.	.	.
2.71	0.0050	0.02	Q	.	.	.	.
2.90	0.0054	0.02	Q	.	.	.	.
3.09	0.0058	0.02	Q	.	.	.	.
3.27	0.0062	0.02	Q	.	.	.	.
3.46	0.0066	0.03	Q	.	.	.	.
3.65	0.0069	0.03	Q	.	.	.	.
3.83	0.0073	0.03	Q	.	.	.	.
4.02	0.0077	0.03	Q	.	.	.	.
4.21	0.0081	0.03	Q	.	.	.	.
4.40	0.0085	0.03	Q	.	.	.	.
4.58	0.0090	0.03	Q	.	.	.	.
4.77	0.0094	0.03	Q	.	.	.	.
4.96	0.0098	0.03	Q	.	.	.	.
5.14	0.0102	0.03	Q	.	.	.	.
5.33	0.0106	0.03	Q	.	.	.	.
5.52	0.0111	0.03	Q	.	.	.	.
5.71	0.0115	0.03	Q	.	.	.	.
5.89	0.0119	0.03	Q	.	.	.	.
6.08	0.0124	0.03	Q	.	.	.	.
6.27	0.0128	0.03	Q	.	.	.	.
6.45	0.0133	0.03	Q	.	.	.	.
6.64	0.0138	0.03	Q	.	.	.	.
6.83	0.0142	0.03	Q	.	.	.	.
7.02	0.0147	0.03	Q	.	.	.	.
7.20	0.0152	0.03	Q	.	.	.	.
7.39	0.0157	0.03	Q	.	.	.	.
7.58	0.0162	0.03	Q	.	.	.	.
7.76	0.0166	0.03	Q	.	.	.	.
7.95	0.0172	0.03	Q	.	.	.	.
8.14	0.0177	0.03	Q	.	.	.	.
8.33	0.0182	0.03	Q	.	.	.	.
8.51	0.0187	0.03	Q	.	.	.	.
8.70	0.0193	0.04	Q	.	.	.	.
8.89	0.0198	0.04	Q	.	.	.	.
9.07	0.0204	0.04	Q	.	.	.	.
9.26	0.0209	0.04	Q	.	.	.	.
9.45	0.0215	0.04	Q	.	.	.	.

```
 9.64      0.0221      0.04  Q         .         .         .         .
 9.82      0.0227      0.04  Q         .         .         .         .
10.01      0.0233      0.04  Q         .         .         .         .
10.20      0.0239      0.04  Q         .         .         .         .
10.39      0.0245      0.04  Q         .         .         .         .
10.57      0.0252      0.04  Q         .         .         .         .
10.76      0.0258      0.04  Q         .         .         .         .
10.95      0.0265      0.04  Q         .         .         .         .
11.13      0.0272      0.04  Q         .         .         .         .
11.32      0.0279      0.05  Q         .         .         .         .
11.51      0.0286      0.05  Q         .         .         .         .
11.70      0.0293      0.05  Q         .         .         .         .
11.88      0.0301      0.05  Q         .         .         .         .
12.07      0.0309      0.05  Q         .         .         .         .
12.26      0.0318      0.06  Q         .         .         .         .
12.44      0.0328      0.07  Q         .         .         .         .
12.63      0.0338      0.07  Q         .         .         .         .
12.82      0.0348      0.07  Q         .         .         .         .
13.01      0.0359      0.07  Q         .         .         .         .
13.19      0.0371      0.07  Q         .         .         .         .
13.38      0.0382      0.08  Q         .         .         .         .
13.57      0.0394      0.08  Q         .         .         .         .
13.75      0.0407      0.08  Q         .         .         .         .
13.94      0.0420      0.09  Q         .         .         .         .
14.13      0.0434      0.09  Q         .         .         .         .
14.32      0.0448      0.10  Q         .         .         .         .
14.50      0.0464      0.10  Q         .         .         .         .
14.69      0.0481      0.11  Q         .         .         .         .
14.88      0.0499      0.12  Q         .         .         .         .
15.06      0.0518      0.13  Q         .         .         .         .
15.25      0.0542      0.17  Q         .         .         .         .
15.44      0.0574      0.24  Q         .         .         .         .
15.63      0.0612      0.25  .Q        .         .         .         .
15.81      0.0674      0.55  . Q       .         .         .         .
16.00      0.0786      0.91  .  Q      .         .         .         .
16.19      0.1130      3.54  .         .   Q     .         .         .
16.37      0.1432      0.36  .Q        .         .         .         .
16.56      0.1476      0.22  Q         .         .         .         .
16.75      0.1503      0.13  Q         .         .         .         .
16.94      0.1521      0.11  Q         .         .         .         .
17.12      0.1537      0.10  Q         .         .         .         .
17.31      0.1551      0.08  Q         .         .         .         .
17.50      0.1563      0.08  Q         .         .         .         .
17.68      0.1575      0.07  Q         .         .         .         .
17.87      0.1586      0.07  Q         .         .         .         .
18.06      0.1596      0.06  Q         .         .         .         .
18.25      0.1605      0.05  Q         .         .         .         .
18.43      0.1613      0.05  Q         .         .         .         .
18.62      0.1620      0.05  Q         .         .         .         .
18.81      0.1627      0.04  Q         .         .         .         .
```

```
  18.99      0.1633      0.04  Q         .         .         .         .
  19.18      0.1639      0.04  Q         .         .         .         .
  19.37      0.1646      0.04  Q         .         .         .         .
  19.56      0.1651      0.04  Q         .         .         .         .
  19.74      0.1657      0.04  Q         .         .         .         .
  19.93      0.1662      0.03  Q         .         .         .         .
  20.12      0.1668      0.03  Q         .         .         .         .
  20.30      0.1673      0.03  Q         .         .         .         .
  20.49      0.1678      0.03  Q         .         .         .         .
  20.68      0.1683      0.03  Q         .         .         .         .
  20.87      0.1687      0.03  Q         .         .         .         .
  21.05      0.1692      0.03  Q         .         .         .         .
  21.24      0.1697      0.03  Q         .         .         .         .
  21.43      0.1701      0.03  Q         .         .         .         .
  21.61      0.1705      0.03  Q         .         .         .         .
  21.80      0.1710      0.03  Q         .         .         .         .
  21.99      0.1714      0.03  Q         .         .         .         .
  22.18      0.1718      0.03  Q         .         .         .         .
  22.36      0.1722      0.03  Q         .         .         .         .
  22.55      0.1726      0.02  Q         .         .         .         .
  22.74      0.1729      0.02  Q         .         .         .         .
  22.93      0.1733      0.02  Q         .         .         .         .
  23.11      0.1737      0.02  Q         .         .         .         .
  23.30      0.1740      0.02  Q         .         .         .         .
  23.49      0.1744      0.02  Q         .         .         .         .
  23.67      0.1748      0.02  Q         .         .         .         .
  23.86      0.1751      0.02  Q         .         .         .         .
  24.05      0.1754      0.02  Q         .         .         .         .
  24.24      0.1756      0.00  Q         .         .         .         .
 -----------------------------------------------------------------------------
--------------------------------------------------------------------------------
   TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
   (Note: 100% of Peak Flow Rate estimate assumed to have
   an instantaneous time duration)

   Percentile of Estimated                 Duration
       Peak Flow Rate                      (minutes)
   =======================                 =========
              0%                             1448.7
             10%                               44.9
             20%                               22.5
             30%                               11.2
             40%                               11.2
             50%                               11.2
             60%                               11.2
             70%                               11.2
             80%                               11.2
             90%                               11.2

  Problem Descriptions:
```

```
  GREAT SCOTT
  UNIT HYDROGRAPH - PROPOSED CONDITION
  2 YR AMC I V.AGUIRRE 6/16/2021
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =     2.73
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.086
    LOW LOSS FRACTION = 0.484
    TIME OF CONCENTRATION(MIN.) = 12.04
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =      0.25
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =      0.21

****************************************************************************
  TIME      VOLUME        Q     0.         2.5        5.0        7.5       10.0
 (HOURS)     (AF)       (CFS)
----------------------------------------------------------------------------
  0.15       0.0002       0.04  Q          .          .          .          .
  0.35       0.0009       0.04  Q          .          .          .          .
  0.55       0.0016       0.04  Q          .          .          .          .
  0.75       0.0023       0.04  Q          .          .          .          .
  0.95       0.0030       0.04  Q          .          .          .          .
  1.15       0.0037       0.04  Q          .          .          .          .
  1.35       0.0044       0.04  Q          .          .          .          .
  1.55       0.0051       0.04  Q          .          .          .          .
  1.75       0.0058       0.04  Q          .          .          .          .
  1.95       0.0065       0.04  Q          .          .          .          .
  2.15       0.0072       0.04  Q          .          .          .          .
  2.35       0.0080       0.04  Q          .          .          .          .
  2.56       0.0087       0.04  Q          .          .          .          .
  2.76       0.0095       0.05  Q          .          .          .          .
  2.96       0.0102       0.05  Q          .          .          .          .
  3.16       0.0110       0.05  Q          .          .          .          .
  3.36       0.0118       0.05  Q          .          .          .          .
  3.56       0.0125       0.05  Q          .          .          .          .
  3.76       0.0133       0.05  Q          .          .          .          .
  3.96       0.0141       0.05  Q          .          .          .          .
```

4.16	0.0149	0.05	Q	.	.	.	.
4.36	0.0157	0.05	Q	.	.	.	.
4.56	0.0165	0.05	Q	.	.	.	.
4.76	0.0174	0.05	Q	.	.	.	.
4.96	0.0182	0.05	Q	.	.	.	.
5.16	0.0190	0.05	Q	.	.	.	.
5.36	0.0199	0.05	Q	.	.	.	.
5.57	0.0208	0.05	Q	.	.	.	.
5.77	0.0216	0.05	Q	.	.	.	.
5.97	0.0225	0.05	Q	.	.	.	.
6.17	0.0234	0.05	Q	.	.	.	.
6.37	0.0243	0.05	Q	.	.	.	.
6.57	0.0252	0.06	Q	.	.	.	.
6.77	0.0262	0.06	Q	.	.	.	.
6.97	0.0271	0.06	Q	.	.	.	.
7.17	0.0281	0.06	Q	.	.	.	.
7.37	0.0291	0.06	Q	.	.	.	.
7.57	0.0300	0.06	Q	.	.	.	.
7.77	0.0310	0.06	Q	.	.	.	.
7.97	0.0320	0.06	Q	.	.	.	.
8.17	0.0331	0.06	Q	.	.	.	.
8.37	0.0341	0.06	Q	.	.	.	.
8.58	0.0352	0.06	Q	.	.	.	.
8.78	0.0363	0.07	Q	.	.	.	.
8.98	0.0374	0.07	Q	.	.	.	.
9.18	0.0385	0.07	Q	.	.	.	.
9.38	0.0396	0.07	Q	.	.	.	.
9.58	0.0408	0.07	Q	.	.	.	.
9.78	0.0420	0.07	Q	.	.	.	.
9.98	0.0432	0.07	Q	.	.	.	.
10.18	0.0444	0.08	Q	.	.	.	.
10.38	0.0457	0.08	Q	.	.	.	.
10.58	0.0469	0.08	Q	.	.	.	.
10.78	0.0483	0.08	Q	.	.	.	.
10.98	0.0496	0.08	Q	.	.	.	.
11.18	0.0510	0.08	Q	.	.	.	.
11.38	0.0524	0.09	Q	.	.	.	.
11.59	0.0539	0.09	Q	.	.	.	.
11.79	0.0553	0.09	Q	.	.	.	.
11.99	0.0569	0.09	Q	.	.	.	.
12.19	0.0586	0.12	Q	.	.	.	.
12.39	0.0606	0.12	Q	.	.	.	.
12.59	0.0626	0.13	Q	.	.	.	.
12.79	0.0647	0.13	Q	.	.	.	.
12.99	0.0669	0.13	Q	.	.	.	.
13.19	0.0691	0.14	Q	.	.	.	.
13.39	0.0715	0.14	Q	.	.	.	.
13.59	0.0739	0.15	Q	.	.	.	.
13.79	0.0764	0.16	Q	.	.	.	.
13.99	0.0791	0.16	Q	.	.	.	.

14.19	0.0819	0.18	Q	.	.	.	.
14.39	0.0849	0.19	Q	.	.	.	.
14.60	0.0882	0.20	Q	.	.	.	.
14.80	0.0916	0.21	Q	.	.	.	.
15.00	0.0955	0.25	.Q	.	.	.	.
15.20	0.1000	0.28	.Q	.	.	.	.
15.40	0.1054	0.37	.Q	.	.	.	.
15.60	0.1114	0.35	.Q	.	.	.	.
15.80	0.1193	0.60	. Q	.	.	.	.
16.00	0.1318	0.91	. Q	.	.	.	.
16.20	0.1654	3.14	.	. Q	.	.	.
16.40	0.1951	0.44	.Q	.	.	.	.
16.60	0.2014	0.32	.Q	.	.	.	.
16.80	0.2060	0.23	Q	.	.	.	.
17.00	0.2095	0.20	Q	.	.	.	.
17.20	0.2125	0.17	Q	.	.	.	.
17.40	0.2152	0.15	Q	.	.	.	.
17.61	0.2176	0.14	Q	.	.	.	.
17.81	0.2198	0.13	Q	.	.	.	.
18.01	0.2219	0.12	Q	.	.	.	.
18.21	0.2237	0.10	Q	.	.	.	.
18.41	0.2253	0.09	Q	.	.	.	.
18.61	0.2267	0.09	Q	.	.	.	.
18.81	0.2281	0.08	Q	.	.	.	.
19.01	0.2294	0.08	Q	.	.	.	.
19.21	0.2307	0.07	Q	.	.	.	.
19.41	0.2319	0.07	Q	.	.	.	.
19.61	0.2330	0.07	Q	.	.	.	.
19.81	0.2342	0.07	Q	.	.	.	.
20.01	0.2352	0.06	Q	.	.	.	.
20.21	0.2363	0.06	Q	.	.	.	.
20.41	0.2373	0.06	Q	.	.	.	.
20.62	0.2383	0.06	Q	.	.	.	.
20.82	0.2392	0.06	Q	.	.	.	.
21.02	0.2402	0.06	Q	.	.	.	.
21.22	0.2411	0.05	Q	.	.	.	.
21.42	0.2420	0.05	Q	.	.	.	.
21.62	0.2428	0.05	Q	.	.	.	.
21.82	0.2437	0.05	Q	.	.	.	.
22.02	0.2445	0.05	Q	.	.	.	.
22.22	0.2453	0.05	Q	.	.	.	.
22.42	0.2461	0.05	Q	.	.	.	.
22.62	0.2469	0.05	Q	.	.	.	.
22.82	0.2477	0.05	Q	.	.	.	.
23.02	0.2484	0.04	Q	.	.	.	.
23.22	0.2491	0.04	Q	.	.	.	.
23.42	0.2499	0.04	Q	.	.	.	.
23.63	0.2506	0.04	Q	.	.	.	.
23.83	0.2513	0.04	Q	.	.	.	.
24.03	0.2519	0.04	Q	.	.	.	.

```
 24.23      0.2523      0.00  Q         .         .         .         .
 ----------------------------------------------------------------------------
```

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1444.8
10%	84.3
20%	24.1
30%	12.0
40%	12.0
50%	12.0
60%	12.0
70%	12.0
80%	12.0
90%	12.0

Appendix E

O&M

Operation and maintenance of dry swale (grass swale)

Green Infrastructure: Dry swales can be an important tool for retention and detention of stormwater runoff. Depending on design and construction, swales may provide additional benefits, including cleaner air, carbon sequestration, improved biological habitat, and aesthetic value. See the section Green Infrastructure for stormwater management.

The most frequently cited maintenance concern for dry swales is surface soil/media and underdrain (https://stormwater.pca.state.mn.us/index.php?title=Glossary#U) clogging caused by organic matter, fine silts, hydrocarbons, and algal matter. Common operational problems include:

- standing water after required 48 hour drawdown time;
- clogged soil/media surface;
- clogged inlet, outlet or underdrains; and
- invasive plants that out-compete native vegetation.

Photo of a well-maintained dry swale. Courtesy of Limnotech.

Contents

Design phase maintenance

Implicit in the design guidance is the fact that many design elements of infiltration (https://stormwater.pca.state.mn.us/index.php?title=Glossary#F) and filtration (https://stormwater.pca.state.mn.us/index.php?title=Glossary#F) systems can minimize the maintenance burden and maintain pollutant removal efficiency. Key examples include:

- limiting drainage area;
- providing easy site access (REQUIRED);
- providing pretreatment (REQUIRED); and
- utilizing native plantings (see Plants for Stormwater Design (https://www.pca.state.mn.us/water/plants-stormwater-design) and Minnesota plant lists).

For more information on design information for dry swales, link here (https://stormwater.pca.state.mn.us/index.php?title=Design_criteria_for_dry_swale_(grass_swale)).

Construction phase maintenance

Proper construction methods and sequencing play a significant role in reducing problems with operation and maintenance (O&M). In particular, with construction of filtration and infiltration practices the most important action for preventing operation and maintenance difficulties is to ensure that the contributing drainage area has been fully stabilized prior to bringing the practice on line.

Warning: It is required that the contributing drainage area has been fully stabilized prior to bringing the practice on line

Inspections during construction are needed to ensure that the filtration or infiltration practice is built in accordance with the approved design standards and specifications. Detailed inspection checklists should be used that include sign-offs by qualified individuals at critical stages of construction, to ensure that the contractor's interpretation of the plan is acceptable to the professional designer. An example construction phase inspection checklist is provided below.

Dry swale construction inspection checklist.
Link to this table
To access an Excel version of form (for field use), click here.

Project:
Location:
Site Status:
Date:
Time:
Inspector:

Construction Sequence	Satisfactory / Unsatisfactory	Comments
1. Pre-Construction		

Pre-construction meeting
Runoff diverted (Note type of bypass)
Facility area cleared
Soil tested for permeability
Soil tested for phosphorus content (include test method)
Verify site was not overdug
Project benchmark near site
Facility location staked out
Temporary erosion and sediment protection properly installed

2. Excavation

Lateral slopes completely level
Soils not compacted during excavation
Longitudinal slopes within design range
Stockpile location not adjacent to excavation area and stabilized with vegetation and/ or silt fence
Verify stockpile is not causing compaction and that it is not eroding
Was underlying soil ripped or loosened
Size, location, and inverts per plans
Side slopes stable
Groundwater / bedrock verified

3. Structural Components

Stone diaphragm installed per plans
Outlets installed pre plans
Check dams installed per plans
Underdrain installed to grade
Pretreatment devices installed per plans
Soil bed composition and texture conforms to specifications
Inlets installed per plans
Underdrain installed per plans

4. Vegetation

For native dry swales, plants and materials ordered 6 months prior to construction
For native dry swales, construction planned to allow for adequate planting and establishment of plant community
Complies with planting specs
Topsoil complies with specs in composition and placement
Soil properly stabilized for permanent erosion control

5. Final Inspection

Dimensions per plans
Pretreatment operational
Check dams operational
Inlet/outlet/underdrain operational
Soil/media/filter bed permeability verified
Effective stand of vegetation stabilized

Construction generated sediments removed
Contributing watershed stabilized before flow is diverted to the practice
Comments:
Actions to be taken:

Post-construction operation and maintenance

Proper maintenance is critical to the successful operation of a filtration or infiltration practice. Without regular maintenance, the soil or media of the filtration or infiltration systems can become clogged, losing its ability to conduct and infiltrate water at the designed rate. This can lead to stagnant water, mosquito breeding habitat, and reduction or elimination of pollutant removal capacity.

Warning: A maintenance plan clarifying maintenance responsibility is REQUIRED. Effective long-term operation of filtration and infiltration practices necessitates a dedicated and routine maintenance schedule with clear guidelines and schedules. Proper maintenance will not only increase the expected lifespan of the facility but will improve aesthetics and property value.

Inspection and maintenance planning

A maintenance plan clarifying maintenance responsibilities is REQUIRED. Effective long-term operation of filtration and infiltration practices necessitates a dedicated and routine maintenance schedule with clear guidelines and schedules. Proper maintenance will not only increase the expected lifespan of the facility but will improve aesthetics and property value. Some important post-construction considerations are provided below along with RECOMMENDED maintenance standards.

- A site-specific O&M plan that includes the following considerations should be prepared by the designer prior to putting the stormwater practice into operation:
  - Inspection and routine maintenance checklist (see below)
  - Operating instructions for any outlet components
  - Vegetation maintenance schedule (see item 2 in checklist below and section below (https://stormwater.pca.state.mn.us/index.php?title=Operation_and_maintenance_of_dry_swale_(grass_swale)#Summary_of_typical_maintenance_regime))
- A legally binding and enforceable maintenance agreement should be executed between the practice owner and the local review authority to ensure the following:
  - Sediment should be cleaned out of any sedimentation chamber when it accumulates to a depth equal to ½ the total depth to the outlet, or when greater than 1.5 feet, whichever is less. The sediment chamber outlet devices should be cleaned/repaired when drawdown times exceed 36 hours. Trash and debris should be removed as necessary; and
  - Silt/sediment should be removed from the swale bottom when the accumulation exceeds one inch. When the soil/media's infiltration capacity diminishes substantially (i.e., when water ponds in flat areas or subtle depressions for more than 48 hours), the top few inches of discolored material (visually different from the unclogged soil below) should be removed, core aeration or cultivation should be conducted as warranted, removed soil should be replaced with fresh soil/media, and appropriate vegetation should be installed (e.g., seed) and secured (e.g., erosion control blanket (https://stormwater.pca.state.mn.us/index.php?title=Erosion_prevention_practices_-_erosion_control_blankets_and_anchoring_devices)). Removed sediments should be disposed in an acceptable manner.
- Turf grass swales should be mowed as needed during the growing season to maintain grass heights between 4 and 12 inches.

- Adequate access must be provided for inspection, maintenance and landscaping upkeep, including appropriate equipment and vehicles.
- Maintenance activities should be careful not to cause compaction. No vehicles will be allowed within the footprint of the filtration or infiltration area. Foot traffic and stockpiling should be kept to a minimum.
- Dry swales generally should not be used as dedicated snow storage areas, but can be with the following considerations.
  - Snow storage should not occur in areas designated as potential stormwater hotspots (https://stormwater.pca.state.mn.us/index.php?title=Potential_stormwater_hotspots) for road salt.
  - Areas designed for infiltration should be protected from excessive snow storage where sand and salt is applied.
  - Specific snow storage areas should be assigned that will provide some filtration before the stormwater reaches the BMP areas. NOTE: Chloride will not be attenuated in filtration or infiltration BMPs such as dry swales.
  - When used for snow storage, or if used to treat parking lot runoff, the BMP area should be planted with salt tolerant and non-woody plant species (https://stormwater.pca.state.mn.us/index.php?title=Minnesota_plant_lists#Salt_tolerance).
  - BMPs should always be inspected for sand build-up on the surface following the spring melt event.
  - General maintenance activities and schedule are provided below.

Dry swale operation and maintenance checklist.
Link to this table
To access an Excel version of form (for field use), click here.

Project:
Location:
Site Status:
Date:
Time:
Inspector:

Maintenance Item	Satisfactory / Unsatisfactory	Comments
1. Debris Cleanout (Monthly)		
Contributing areas clean of litter and vegetative debris		
Filtration or infiltration facility clean		
Inlets and outlets clear		
2. Vegetation (Monthly)		
Vegetation maintenance complies with O&M plan		
Vegetation meets performance standards (including control of specified invasive species)		
Plant composition according to O&M plan		
Minimum mowing depth not exceeded		
No evidence of erosion		
3. Dewatering (monthly)		
Dewaters between storms within 48 hours		
4. Sediment Deposition (Annual)		
Area clean of sediment		
Contributing drainage area stabilized and free of erosion		
Winter accumulation of sand removed each spring		
5. Outlet/Overflow Spillway (Annual, After Major Storms)		

Good condition, no need for repair
No evidence of erosion
No evidence of any blockages
No evidence of structural deterioration

6. Other (Monthly)

Encroachment on easement area (if applicable)
Complaints from residents (if applicable)
Any public hazards (specify)
Comments:
Actions to be taken:

Summary of typical maintenance regime

The list below highlights the assumed maintenance regime for a dry swale.

- First year after planting
  - Adequate water is crucial to plant survival and temporary irrigation may be needed unless rainfall is adequate until plants mature
  - Inspect after significant rain events (e.g. >0.5 inch)
- As needed
  - Prune and weed to maintain appearance
  - Remove trash and debris
  - Mow filter strip/grass channel (if present)
  - Replace vegetation whenever the percent cover of acceptable vegetation falls below 90 percent or project specific performance requirements are not met. If vegetation suffers for no apparent reason, consult with horticulturist and/or test soil as needed
  - Repair any structural damage to check dams (https://stormwater.pca.state.mn.us/index.php?title=Check_dams_for_stormwater_swales) or tie-in to downstream channel
- Semi-annually
  - Inspect inflow and pretreatment systems for clogging (off-line systems) and remove any sediment
  - Inspect filter strip/grass channel for erosion or gullying. Sod as necessary
  - Herbaceous vegetation, trees and shrubs should be inspected to evaluate their health and replanted as appropriate to meet project goals
  - Remove any dead or severely diseased vegetation
- Annually in fall
  - Inspect and remove any sediment and debris build-up in pretreatment areas
  - Inspect inflow points and infiltration surface for buildup of road sand associated with spring melt period, remove as necessary to maintain infiltration rates and volume capacity, and replant areas that have been impacted by sand/salt build up
  - Check structural stability of check dams
- Annually in spring
  - Cut back and remove previous year’s plant material and remove accumulated leaves if needed (or conduct controlled burn where appropriate)

Estimated hours to perform maintenance activities

All estimated hours listed below would be to perform maintenance on a dry swale system approximately 1,000 square feet in size that has adequate pretreatment and where seed and/or live plants have been installed appropriately. The times do not include travel times.

- Plant Establishment Period (First two years)
  - Monthly weeding – 12 visits (6 per year) at 1 hour per visit
  - Vegetation replacement – 1 overseeding or replanting effort, 2 hours (assuming 10 percent warrants replacement)
  - Spring cleanup (cut back of previous years vegetation) – 2 cleanups (1 per year) at 2 hours each
  - Erosion, sediment, and pretreatment cleanout – 2 cleanouts (1 per year) at 1 hour each (assuming vacuum truck clean-out of any sump catch basins)
- Regular Maintenance (After first two years)
  - Bi-monthly (every other month) weeding – 3 visits per year at 1 hour per visit
  - Vegetation replacement – 1 overseeding or replanting effort per year on average, 1 hour (assuming 5 percent warrants replacement)
  - Spring cleanup (cut back of previous years vegetation) – 1 per year at 2 hours
  - Erosion, sediment, and pretreatment cleanout – 2 hours per year on average (assuming vacuum truck clean-out of any sump catch basins once per year, and at least one bi-yearly (every other year) sediment removal from the bottom of the swale)

Erosion protection and sediment monitoring, removal, and disposal

Regular inspection of not only the BMP but also the immediate surrounding catchment area is necessary to ensure a long lifespan of the water quality improvement feature. Erosion should be identified as soon as possible to avoid the contribution of significant sediment to the BMP.

Pretreatment devices need to be maintained for long-term functionality of the entire BMP. Accumulated sediment in filter strips, rock diaphragms, water quality sump catch basins, or any pretreatment features will need to be inspected yearly.

Timing of cleaning of these features is dependent on their design and sediment storage capabilities. In watersheds with erosion or high sediment loadings, the frequency of clean out will likely be increased. A vacuum truck is typically used for sediment removal. It is possible that any sediment removed from pretreatment devices or from the bottom of a dry swale may contain high levels of pollutants. All sediments, similar to those retrieved from a stormwater pond during dredging, may be subjected to the MPCA's guidance for reuse and disposal (https://www.pca.state.mn.us/sites/default/files/wq-strm4-16.pdf).

Sediment loading can potentially lead to a drop in infiltration or filtration rates. It is recommended that infiltration performance evaluations follow the four level assessment systems in Stormwater Treatment: Assessment and Maintenance (http://stormwaterbook.safl.umn.edu/) (Gulliver et al., 2010). See Assessing the performance of dry swale (grass swale) for a summary of assessment methods.

Seeding, planting, and landscaping maintenance

Plant selection during the design process is essential to limit the amount of maintenance required. It is also critical to identify who will be maintaining the BMP in perpetuity and to design the plantings or seedings accordingly. The decision to install containerized plants or to seed will dictate the appearance of the BMP for years to come. If the BMP is designed to be seeded with an appropriate native plant based seed mix, it is essential the owner have trained staff or the ability to hire specialized management professionals. Seedings can provide plant diversity and dense coverage that helps maintain drawdown rates, but landscape management professionals that have not been trained to identify and appropriately manage weeds within the seeding may inadvertently allow the BMP to become infested and the designed plant diversity be lost. The following are minimum requirements for seed establishment and plant coverage.

- At least 50 percent of specified vegetation cover at end of the first growing season, not including REQUIRED cover crop

- At least 90 percent of specified vegetation cover at end of the third growing season, not including REQUIRED cover crop
- Supplement seeding/plantings to meet project specifications if cover requirements are not met
- Tailor percent coverage requirements to project goals and vegetation. For example, percent cover required for turf after one growing season would likely be 100 percent, whereas it would be lower for other vegetation types.

For information on plant selection, link here (https://stormwater.pca.state.mn.us/index.php/Minnesota_plant_lists) or link here (https://stormwater.pca.state.mn.us/index.php?title=Plants_for_swales).

For proper nutrient control, swales must not be fertilized unless a soil test from a certified lab indicates nutrient deficiency. If this is the case, apply the minimum rate of appropriate nutrients to provide a suitable environment for vegetation establishment while also minimizing the mobilization (and loss) of nutrients to downstream receiving waters. Irrigation may be needed during establishment, depending on soils, precipitation, and if stormwater flows are kept off-line during establishment.

Weeding is especially important during the plant establishment period, when vegetation cover is not 100 percent yet. Some weeding will always be needed. It is also important to budget for some plant replacement (at least 5 to 10 percent of the original plantings or seedings) during the first few years in case some of the plants or seed that were originally installed don't become vigorous. It is HIGHLY RECOMMENDED that the install contractor be responsible for a plant warranty period. Typically, plant warranty periods can be 60 days or up to one year from preliminary acceptance through final inspections. If budget allows, installing larger plants (#1 container vs. 4" pot) during construction can decrease replacement rates if properly cared for during the establishment period.

Weeding in years after initial establishment should be targeted and thorough. Total eradication of aggressive weeds at each maintenance visit will ultimately reduce the overall effort required to keep the BMP weed free. Mulch is generally not recommended for use in swales since flowing water typically washes it downstream; however, mulch may be appropriate in planting beds or around individual trees on upper sideslopes and adjacent areas.

Rubbish and trash removal will likely be needed more frequently than in the adjacent landscape. Trash removal is important for prevention of mosquitoes and for the overall appearance of the BMP.

Sustainable service life

The service life of swales depends upon the pollutant of concern.

Infiltration rate service life before clogging

It is known that plant roots are essential in macropore formation, which helps maintain infiltration into soil. If proper pretreatment is present, service life for infiltration should be unlimited. However, if construction site runoff (or another source of fines) is not prevented from entering the swale, clogging will occur, limiting or eliminating the infiltration function of the system, thus requiring restorative maintenance or repair (Brown and Hunt, 2010).

Nitrogen reduction

Nitrogen removal is not a primary function of dry swales.

Phosphorus reduction

Phosphorus (P) removal in swales is achieved primarily through infiltration and sorption of phosphorus to trapped sediments. Sediment bound phosphorus is removed through sedimentation, while removal of soluble phosphorus depends on the type of soil/media used. If the soil/media is already saturated with P (i.e., its P binding sites are full), it will not be able to retain additional dissolved P and the P in stormwater will tend to leach from the soil/media as it passes through the biofilter (Hunt et al., 2006). It is highly recommended that the P-index of the media at installation be below 30, which equates to less than 36 milligrams per kilogram P, to ensure P removal capacity. Laboratory research has suggested an oxalate extractable P concentration of 20 to 40 milligrams per liter will provide consistent removal of P (O'Neill and Davis, 2012). Leaching of phosphorus from soil or media is a concern for filtration swales (those having an underdrain). For information on phosphorus leaching from bioretention media, link here (https://stormwater.pca.state.mn.us/index.php?title=Design_criteria_for_bioretention#Addressing_phosphorus_leaching_concerns_with_media_mixes).

Heavy metals retention

Metals are typically retained in infiltration systems (including dry swales) through sedimentation and adsorption processes. Since there are a finite amount of sorption sites for metals in a particular soil/media, there will be a finite service life for the removal of dissolved metals. Morgan et al. (2011) investigated cadmium, copper, and zinc removal and retention with batch and column experiments. Using synthetic stormwater at typical stormwater concentrations, they found that 6 inches of filter media composed of 30 percent compost and 70 percent sand will last 95 years until breakthrough (i.e., when the effluent concentration is 10 percent of the influent concentration). They also found that increasing compost from 0 percent to 10 percent more than doubles the expected lifespan for 10 percent breakthrough in 6 inches of filter media for retainage of cadmium and zinc. Using accelerated dosing laboratory experiments, Hatt et al. (2011) found that breakthrough of Zn was observed after 2000 pore volumes, but did not observe breakthrough for Cd, Cu, and Pb after 15 years of synthetic stormwater passed through the media. However, concentrations of Cd, Cu, and Pb on soil/media particles exceeded human and/or ecological health levels, which could have an impact on disposal if the soil/media needed replacement. Since the majority of metals retainage occurs in the upper 2 to 4 inches of the soil/media (Li and Davis, 2008), long-term metals capture may only require rejuvenation of the upper portion of the media.

Polycyclic aromatic hydrocarbons (PAHs) reduction

Accumulation of polycyclic aromatic hydrocarbons (PAHs) in sediments has been found to be so high in some stormwater retention ponds that disposal costs for the dredging spoils were prohibitively high. Research has shown that rain gardens, on the other hand, are "a viable solution for sustainable petroleum hydrocarbon removal from stormwater, and that vegetation can enhance overall performance and stimulate biodegradation." (Lefevre et al., 2012). Dry swales provide some of the same functions as rain gardens, and therefore would be expected to provide some PAH management. However, swale performance in PAH management has not been the focus of any identified studies.

Typical maintenance problems and activities

The following table summarizes common maintenance concerns, suggested actions, and recommended maintenance schedule.

Typical maintenance problems and activities for dry swales
Link to this table

Inspection Focus	Common Maintenance Problems	Maintenance Activity	Recommended Maintenance Schedule

Inspection Focus	Common Maintenance Problems	Maintenance Activity	Recommended Maintenance Schedule
Drainage Area and Drawdown Time	Clogging, sediment deposition	Ensure that contributing catchment areas to practice, and inlets are clear of debris	Monthly
	Erosion of catchment area contributing significant amount of sediment	In case of severely reduced drawdown time, scrape bottom of basin and remove sediment. Disc or otherwise aerate/scarify basin bottom. De-thatch if basin bottom is turf grass. Restore original design cross section or revise section to increase infiltration rate and restore with vegetation as necessary.	Upon identification of drawdown times longer than 48 hours or upon complete failure
Site Erosion	Scouring at inlets	Correct earthwork to promote non-erosive flows that are evenly distributed	As necessary
	Unexpected flow paths into practice	Correct earthwork to eliminate unexpected drainage or created additional stable inlets as necessary	As necessary
Vegetation	Reduced drawdown time damaging plants	Correct drainage issues as described above	Replace with appropriate plants after correction of drainage issues
	Severe weed establishment	Limit the ability for noxious weed establishment by properly mowing, mulching or timely herbicide or hand weeding. Refer to the MDA Noxious Weed List (http://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist.aspx)	Bi-monthly April through October
	Vegetative cover	Add seed/plants to maintain ≥95% vegetative cover.	Bi-monthly April through October

Maintenance agreements

A Maintenance Agreement is a legally binding agreement between two parties, and is defined as ”a nonpossessory right to use and/or enter onto the real property of another without possessing it.“ Maintenance Agreements are often required for the issuance of a permit for construction of a stormwater management feature and are written and approved by legal counsel. Maintenance Agreements are often similar to Construction Easements. A Maintenance Agreement is required for one party to define and enforce maintenance by another party. The Agreement also defines site access and maintenance of any features or infrastructure if the property owner fails to perform the required maintenance.

Maintenance Agreements are commonly established for a defined period such as five years for a residential site or 10 to 20 years for a commercial/governmental site after construction of the infiltration or filtration practice. Maintenance agreements often define the types of inspection and maintenance that would be required for that infiltration or filtration practice and what the timing and duration of the inspections and maintenance may be. Essential inspection and maintenance activities include but are not limited to drawdown time, sediment removal, erosion monitoring and correction, and vegetative maintenance and weeding. If maintenance is required to be performed due to failure of the site owner to properly maintain the infiltration or filtration practices, payment or reimbursement terms of the maintenance work are defined in the Agreement. Below is an example list of maintenance standards from an actual Maintenance Agreement.

1. Live plantings and seeding areas shall be watered as necessary to achieve performance standards.

2. Weeding and vegetation management (e.g., mowing, spot spraying) shall be conducted as necessary to achieve performance standards.
3. Dead plant material, garbage, and other debris shall be removed from the swale at least annually.
4. Silt/sediment should be removed from the swale bottom when the accumulation exceeds one inch.
5. Side slopes must be inspected for erosion and the formation of rills or gullies at least annually, and erosion problems must be corrected immediately.
6. If properly planned, designed, constructed, and maintained (including protected from sediment and compaction and incorporating sufficient pretreatment), a dry swale is likely to retain its effectiveness for well over 20 years. After that time, inspection will reveal whether sedimentation warrants scraping out the swale bottom and replanting it.

In some project areas, a drainage easement may be required. Having an easement provides a mechanism for enforcement of maintenance agreements to help ensure swales are maintained and functioning. Drainage easements also require that the land use not be altered in the future. Drainage easements exist in perpetuity and are required property deed amendment to be passed down to all future property owners.

As defined by the Maintenance Agreement, the landowner should agree to provide notification immediately upon any change of the legal status or ownership of the property. Copies of all duly executed property transfer documents should be submitted as soon as a property transfer is made final.

- Example Maintenance Agreement 1 (https://stormwater.pca.state.mn.us/index.php?title=Example_Maintenance_Agreement_1)
- Example Maintenance Agreement 2 (https://stormwater.pca.state.mn.us/index.php?title=Example_Maintenance_Agreement_2)
- Example Maintenance Agreement 3 (https://stormwater.pca.state.mn.us/index.php?title=Example_Maintenance_Agreement_3)

Maintenance inspection reports

To link to the maintenance inspection report, click here. The contents of the inspection form are provided below. For another source of information on visual indicators, see Chesapeake Stormwater visual indicators form (http://chesapeakestormwater.net/wp-content/uploads/downloads/2012/06/Visual-Indicators-Form.pdf).

Maintenance Inspection Report for Dry Swale with Check Dams and Stormwater Step Pool. Can be used for wet swales with exceptions, as noted in footnotes.

Date: ____

Inspector Name/Address/Phone Number: ____

Site Address: ____

Owner Name/Address/Phone Number: ____

Drainage Area Stabilization (Inspect after large storms for first two years, Inspect yearly in spring or after large storms after first two years)

- Erosion control/planting/seeding necessary: ____
- Mowing, pruning and debris removal necessary: ____
- Observations:

____

____

Inlets & Pretreatment Structures (Inspect in Spring and Fall)

- Repair needed: ____
- Debris & sediment removal required: ____
- Erosion evident: ____
- Water by-passing inlet: ____
- Vegetation control necessary: ____
- Observations:

____
____

Swale (Inspect after large storms for first two years, Inspect yearly in spring or after large storms after first two years)

- Condition of infiltration area[1]: ____
- Condition of check dams: ____
- Surface erosion evident: ____
- Debris/sediment removal required: ____
- Adequate drawdown/standing water[2]: ____
- Weeding and pruning necessary: ____
- Mulch replacement necessary[3]: ____
- Observations:

____
____

Outlet/Emergency Overflow (Inspect in Spring and Fall)

- Overflow type: ____
- Debris/sediment removal required: ____
- Repair needed: ____
- Observations:

____
____

[1]For wet swale, check condition of inundated area

[2]For wet swale with check dam, drawdown applies to the water elevation at the botton of weir

[3]Not applicable for wet swale

Related pages

- Terminology for swales (grass channels)
- Overview for dry swale (grass swale)
- Types of infiltration
- Types of filtration
- Design criteria for dry swale (grass swale)
- Construction specifications for dry swale (grass swale)
- Operation and maintenance of dry swale (grass swale)
- Assessing the performance of dry swale (grass swale)

- Calculating credits for dry swale (grass swale)
- Cost considerations for dry swale (grass swale)
- Case studies for dry swale (grass swale)
- Plants for swales
- Check dams for stormwater swales
- External resources for dry swale (grass swale)
- References for dry swale (grass swale)
- Requirements, recommendations and information for using dry swale (grass swale) without an underdrain in the MIDS calculator (https://stormwater.pca.state.mn.us/index.php?title=Requirements,_recommendations_and_information_for_using_swale_without_an_underdrain_as_a_BMP_in_the_MIDS_calculator)
- Requirements, recommendations and information for using dry swale (grass swale) with an underdrain in the MIDS calculator (https://stormwater.pca.state.mn.us/index.php?title=Requirements,_recommendations_and_information_for_using_swale_with_an_underdrain_as_a_BMP_in_the_MIDS_calculator)
- Requirements, recommendations and information for using swale side slope as a BMP in the MIDS calculator
- Dry swale (grass swale) and interesting websites

Appendix F

Encumbrance Map

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF LAKE FOREST IN THE COUNTY OF ORANGE, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

PARCEL 1:

PARCEL A OF PARCEL MAP NO. 86-133, IN THE CITY OF LAKE FOREST, COUNTY OF ORANGE, STATE OF CALIFORNIA, AS PER MAP ON FILE IN BOOK 225 PAGES 7 TO 13 INCLUSIVE OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

EXCEPT ONE-HALF OF ALL MINERALS, OIL, AND/OR ASPHALTUM OF EVERY KIND OR CHARACTER IN OR UNDER SAID PROPERTY, AND ONE-HALF OF EVERY MINERAL OR OIL RIGHT THEREIN, THEREUNTO AND THEREUNDER, AS EXCEPTED IN THE DEED FROM THE WHITING COMPANY TO BENNIE W. OSTERMAN AND CYNTHIA A. OSTERMAN, RECORDED APRIL 30, 1928, IN BOOK 153 PAGE 320 OF OFFICIAL RECORDS.

PARCEL 2:

PARCEL A: (FEE PARCEL)

THAT PORTION OF LOT(S) F OF TRACT NO. 695, IN THE CITY OF LAKE FOREST, COUNTY OF ORANGE, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 25 PAGE(S) 1 OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT 615.77 FEET NORTH 23°03'40" WEST FROM THE MOST WESTERLY CORNER OF LOT G OF TRACT NO. 695; THENCE NORTH 53°25'30" EAST 160.00 FEET; THENCE NORTH 36°34'30" WEST 167.00 FEET; THENCE SOUTH 56°25'30" WEST 60.00 FEET; THENCE SOUTH 15°36'45" WEST 135.57 FEET; THENCE SOUTH 46°14'30" EAST 95.00 FEET TO THE POINT OF BEGINNING.

EXCEPT THEREFROM ONE-HALF OF ALL MINERALS, OILS AND/OR ASPHALTUM OF EVERY KIND OR CHARACTER IN OR UNDER SAID PROPERTY, AND ONE-HALF OF EVERY MINERAL OR OIL RIGHT THEREIN, THEREUNTO AND THEREUNDER, AND THE RIGHTS AND EASEMENTS IN CONNECTION WITH SAID SUBSTANCES, AS RESERVED BY THE WHITING COMPANY IN THE DEED RECORDED IN BOOK 153 PAGE 320 OF OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID ORANGE COUNTY.

ALSO EXCEPTING WATER AND WATER RIGHTS AS RESERVED BY THE WHITING COMPANY, IN DEED RECORDED IN BOOK 153 PAGE 320 OF OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID ORANGE COUNTY.

PARCEL B: (FEE PARCEL)

THAT PORTION OF LOT(S) F OF TRACT NO. 695, IN THE CITY OF LAKE FOREST, COUNTY OF ORANGE, STATE OF CALIFORNIA, ACCORDING TO THE MAP FILED IN BOOK 25 PAGE(S) 1 OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY BEING ALSO SHOWN AS A PORTION OF A REMAINDER OF PARCEL OF TRACT NO. 11397, ACCORDING TO THE MAP FILED IN BOOK 502 PAGES 44 THROUGH 47 INCLUSIVE OF MISCELLANEOUS MAPS, RECORDS OF ORANGE COUNTY, DESCRIBED AS FOLLOWS:

BEGINNING AT THE MOST EASTERLY CORNER OF THE LAND DESCRIBED IN THE DEED TO RALSTON ANDERSON AND MAXINE E. ANDERSON, RECORDED IN BOOK 2474 PAGE 461, OFFICIAL RECORDS OF SAID ORANGE COUNTY; THENCE NORTH 53°25'30" EAST 69.42 FEET ALONG THE NORTHEASTERLY PROLONGATION OF THE SOUTHEASTERLY LINE OF SAID LAND; THENCE NORTH 36°19'50" WEST 47.29 FEET ALONG A LINE THAT IS PARALLEL WITH AND 5.00 FEET NORTHEASTERLY FROM THE NORTHEASTERLY FACE OF AN EXISTING BAM; THENCE NORTH 53°40'10" EAST 6.60 FEET TO A POINT WHICH IS 5.00 FEET SOUTHEASTERLY AND 1.00 FOOT NORTHEASTERLY FROM THE EASTERLY CORNER OF A 4' X 8' CONCRETE BASE OF A WATER WELL; THENCE NORTH 36°19'50" WEST, 18.00 FEET TO A POINT WHICH IS 5.00 FEET NORTHWESTERLY AND 1.00 FOOT NORTHWESTERLY FROM THE NORTHERLY CORNER OF THE CONCRETE BASE; THENCE SOUTH 53°40'10" WEST, 6.60 FEET TO A POINT THAT IS 5.00 FEET NORTHEASTERLY OF SAID BAM; THENCE NORTH 36°19'50" WEST, 108.71 FEET, PARALLEL WITH THE NORTHWESTERLY PROLONGATION OF THE NORTHEASTERLY FACE OF SAID BAM; THENCE SOUTH 47°43'44" WEST, 70.51 FEET TO THE MOST NORTHERLY COMER OF THE LAND DESCRIBED IN SAID DEED TO RALSTON ANDERSON AND MAXINE E. ANDERSON, THENCE SOUTH 36°34'30" EAST, 167.00 FEET ALONG THE NORTHEASTERLY LINE OF SAID LAND TO THE POINT OF BEGINNING.

EXCEPT THEREFROM ONE-HALF OF ALL MINERALS, OILS AND/OR ASPHALTUM OF EVERY KIND OR CHARACTER IN OR UNDER SAID PROPERTY, AND ONE-HALF OF EVERY MINERAL OR OIL RIGHT THEREIN, THEREUNTO AND THEREUNDER, AND THE RIGHTS AND EASEMENTS IN CONNECTION WITH SAID SUBSTANCES, AS RESERVED BY THE WHITING COMPANY IN THE DEED RECORDED IN BOOK 153 PAGE 320 OF OFFICIAL RECORDS.

ALSO EXCEPTING WATER AND WATER RIGHTS AS RESERVED BY THE WHITING COMPANY, IN DEED RECORDED IN BOOK 153 PAGE 320 OF OFFICIAL RECORDS.

NOTE: PARCELS A AND B ABOVE DESCRIBED ARE SHOWN AS PARCEL 1 ON THE LOT LINE ADJUSTMENT LL 82-30 RECORDED DECEMBER 22, 1982 AS INSTRUMENT NO. 82-449842, OFFICIAL RECORDS.

PARCEL C: (APPURTENANT EASEMENT PARCEL)

A NON-EXCLUSIVE EASEMENT FOR INGRESS AND EGRESS OVER THAT PORTION OF LOT F OF TRACT NO. 695, IN UNINCORPORATED TERRITORY OF THE COUNTY OF ORANGE, STATE OF CALIFORNIA, AS SHOWN ON A MAP RECORDED IN BOOK 25 PAGE 1 OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY INCLUDED WITHIN A STRIP OF LAND, 30.00 FEET IN WIDTH THE CENTERLINE OF SAID STRIP BEING DESCRIBED AS FOLLOWS:

BEGINNING AT THE MOST EASTERLY CORNER OF LOT 1 OF TRACT NO. 11397, AS SHOWN ON A MAP RECORDED IN BOOK 502 PAGES 44 THROUGH 47 INCLUSIVE OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, SAID COMER BEING ALSO THE NORTHWESTERLY LINE OF CANADA ROAD AS SHOWN ON SAID TRACT NO. 11397; THENCE NORTH 39°25'28" EAST 42.00 FEET ALONG SAID NORTHWESTERLY LINE TO THE TRUE POINT OF BEGINNING; THENCE NORTH 50°34'32" WEST 15.81 FEET TO THE BEGINNING OF A TANGENT CURVE CONCAVE SOUTHWESTERLY, HAVING A RADIUS OF 100.00 FEET; THENCE NORTHWESTERLY 73.23 FEEL ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 41°57'24"; THENCE SOUTH 87°28'04" WEST 96.78 FEET TO THE BEGINNING OF A TANGENT CURVE CONCAVE NORTHEASTERLY, HAVING A RADIUS OF 68.00 FEET; THENCE NORTHWESTERLY

LEGAL DESCRIPTION (CONTINUED)

49.52 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 41°43'42" TO THE BEGINNING OF A REVERSE CURVE, CONCAVE SOUTHWESTERLY, HAVING A RECORD OF 68.00 FEET; THENCE NORTHWESTERLY 49.52 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 41°43'42" TO A LINE PARALLEL WITH AND NORTHERLY 15.00 FEET FROM THAT CERTAIN COURSE SHOWN AS "NORTH 87°28'04" EAST 172.53 FEET" FOR A PORTION OF THE NORTHERLY LINE OF SAID LOT 1; THENCE SOUTH 87°28'04" WEST 172.53 FEET ALONG SAID PARALLEL LINE TO THE BEGINNING OF A TANGENT CURVE CONCAVE SOUTHEASTERLY, HAVING A RADIUS OF 68.00 FEET; THENCE SOUTHWESTERLY 41.99 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 35°22'46" TO THE BEGINNING OF A REVERSE CURVE, CONCAVE NORTHERLY, HAVING A RADIUS OF 68.00 FEET; THENCE WESTERLY 99.49 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 83°49'42" TO A LINE PARALLEL WITH AND NORTHEASTERLY 45.00 FEET FROM THAT CERTAIN COURSE SHOWN AS "NORTH 44°05'00" WEST 142.84 FEET FOR A PORTION OF THE NORTHEASTERLY LINE OF SAID LOT 1; THENCE NORTH 44°05'00" WEST 101.68 FEET ALONG SAID LAST MENTIONED PARALLEL LINE TO A LINE PARALLEL WITH AND SOUTHEASTERLY 15.00 FEET FROM THE SOUTHEASTERLY LINE OF THE LAND DESCRIBED IN THE DEED TO DENVER A. NUTTER AND SADIE M. NUTTER RECORDED IN BOOK 247 PAGE 460 OF OFFICIAL RECORDS IN THE OFFICE OF THE COUNTY RECORDER; THENCE NORTH 53°25'30" EAST 257 98 FEET ALONG SAID LAST ABOVE MENTIONED PARALLEL LINE.

PARCEL D: (APPURTENANT EASEMENT PARCEL)

A NON-EXCLUSIVE EASEMENT FOR UTILITY PURPOSES AND INCIDENTAL PURPOSES THERETO OVER THAT PORTION OF LOT F OF TRACT NO. 695, IN THE UNINCORPORATED TERRITORY OF THE COUNTY OF ORANGE, STATE OF CALIFORNIA, AS SHOWN ON THE TERRITORY OF THE COUNTY OF ORANGE, STATE OF CALIFORNIA, AS SHOWN ON A MAP RECORDED IN BOOK 25 PAGE 1 OF MISCELLANEOUS MAPS IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY INCLUDED WITHIN A STRIP OF LAND, 30.00 FEET IN WIDTH, THE CENTERLINE OF SAID STRIP BEING DESCRIBED AS FOLLOWS:

COMMENCING AT THE SOUTHEASTERLY TERMINUS OF THAT CERTAIN COURSE SHOWN AS "NORTH 44°05'00" WEST 142.84 FEET" FOR A PORTION OF THE NORTHEASTERLY LINE OF LOT 1 OF TRACT NO. 11397, AS SHOWN ON A MAP RECORDED IN BOOK 502 PAGES 44 THROUGH 47 INCLUSIVE OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER; THENCE NORTH 45°36'44" EAST 15.00 FEET ALONG THE NORTHWESTERLY LINE OF SAID LOT 1 TO THE TRUE POINT OF BEGINNING, SAID POINT BEING ON LINE PARALLEL WITH AND NORTHEASTERLY 15.00 FEET FROM SAID NORTHEASTERLY LINE; THENCE NORTH 44°05'00" WEST 201.81 FEET ALONG SAID PARALLEL LINE TO A LINE PARALLEL WITH AND SOUTHEASTERLY 15.00 FEET FROM THE SOUTHEASTERLY LINE OF THE LAND DESCRIBED IN THE DEED TO DENVER A. NUTTER AND SADIE M. NUTTER RECORDED IN BOOK 2474 PAGE 460 OF OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER; THENCE NORTH 53°25'30" EAST 288.24 FEET ALONG SAID LAST MENTIONED PARALLEL LINE.

THE SIDELINES OF SAID STRIP TO BE PROLONGED OR SHORTENED TO TERMINATE SOUTHEASTERLY IN SAID NORTHWESTERLY LINE.

PARCEL 3:

PARCEL A: (FEE PARCEL)

THAT PORTION OF LOT F OF TRACT NO. 695, IN THE CITY OF LAKE FOREST, COUNTY OF ORANGE, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 25, PAGE 1 OF MISCELLANEOUS MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID ORANGE COUNTY, CALIFORNIA.

BEGINNING AT A POINT 615.77 FEET NORTH 23°03'40" WEST AND 275.00 FEET NORTH 53°25'30" EAST FROM THE MOST WESTERLY CORNER OF LOT G OF SAID TRACT NO. 695; THENCE NORTH 53°25'30" EAST 132.00 FEET; THENCE NORTH 33°34'30" WEST 90.00 FEET; THENCE SOUTH 53°25'30" WEST 132.00 FEET; THENCE SOUTH 33°34'30" EAST 90.00 FEET TO THE POINT OF BEGINNING.

EXCEPT ONE-HALF OF ALL MINERALS, OIL, AND/OR ASPHALTUM OF EVERY KIND OR CHARACTER IN OR UNDER SAID PROPERTY, AND ONE-HALF OF EVERY MINERAL OR OIL RIGHT THEREIN, THEREUNTO AND THEREUNDER, AS RESERVED BY THE WHITING COMPANY IN DEED RECORDED APRIL 30, 1928 IN BOOK 153, PAGE 320 OF OFFICIAL RECORDS.

PARCEL B: (APPURTENANT EASEMENT PARCEL)

A NON-EXCLUSIVE EASEMENT TO BE USED IN COMMON WITH OTHERS FOR INGRESS AND EGRESS, OVER THAT PORTION OF SAID LAND, INCLUDED WITHIN A STRIP OF LAND 30.00 FEET IN WIDTH, THE SOUTHWESTERLY AND NORTHWESTERLY LINES OF WHICH ARE DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT IN THE CENTERLINE OF CANADA ROAD, AS CONVEYED TO THE COUNTY OF ORANGE BY DEED RECORDED SEPTEMBER 26, 1938 IN BOOK 960, PAGES 514 OF OFFICIAL RECORDS OF ORANGE COUNTY, CALIFORNIA, SAID POINT BEING LOCATED 190.03 FEET NORTH 45°34'45" EAST AND 66.42 FEET SOUTH 44°05' EAST FROM THE MOST WESTERLY CORNER OF LOT G, TRACT NO. 695, AS PER MAP RECORDED IN BOOK 25, PAGE 1 OF MISCELLANEOUS MAPS, RECORDS OF ORANGE COUNTY, CALIFORNIA, RUNNING FROM SAID POINT OF BEGINNING NORTH 44°05' WEST 644.00 FEET; THENCE 53°25'30" EAST 438.00 FEET, AS SHOWN BY DEED RECORDED APRIL 25, 1961 IN BOOK 5700, PAGE 204 OF OFFICIAL RECORDS.

PARCEL C: (FEE PARCEL)

THE PARCEL OF LAND IN THE COUNTY OF ORANGE, STATE OF CALIFORNIA, DESCRIBED IN DEED RECORDED MARCH 24, 1953 IN BOOK 2474, PAGE 460 OF OFFICIAL RECORDS OF SAID COUNTY, TOGETHER WITH THAT PORTION OF LOT "F", TRACT NO. 695, AS SHOWN ON MAP RECORDED IN BOOK 25, PAGE 1 OF MISCELLANEOUS MAPS, RECORDS OF SAID COUNTY (MORE PARTICULARLY SHOWN AS "REMAINDER PARCEL" ON MAP OF SAID TRACT NO. 11397 RECORDED IN BOOK 502, PAGES 44 THROUGH 47 INCLUSIVE OF MISCELLANEOUS MAPS), DESCRIBED AS FOLLOWS:

BEGINNING AT THE WESTERLY CORNER OF SAID LAND DESCRIBED IN SAID DEED RECORDED MARCH 24, 1953 IN BOOK 2474, PAGE 460 OF OFFICIAL RECORDS; THENCE NORTH 33°34'30" WEST ALONG THE NORTHWESTERLY PROLONGATION OF THE SOUTHWESTERLY LINE OF SAID LAND 50.00 FEET; THENCE NORTH 74°31'39" EAST 138.68 FEET TO THE NORTHERLY CORNER OF SAID LAND; THENCE SOUTH 53°25'30" WEST ALONG THE NORTHWESTERLY LINE OF SAID LAND 132.00 FEET TO THE POINT OF BEGINNING OF THIS DESCRIPTION.

TITLE REPORT INFORMATION

ITEM NUMBERS AND LEGAL DESCRIPTION SHOWN HEREON CORRESPOND TO FIDELITY NATIONAL TITLE INSURANCE COMPANY PRELIMINARY TITLE REPORT NO. 989-30062340-A-BAM, DATED APRIL 19, 2021; AMENDED APRIL 27, 2021, AMENDMENT NO. A

NO RESPONSIBILITY FOR COMPLETENESS, ACCURACY OR CONTENT OF SAID REPORT IS ASSUMED BY THIS MAP.

ITEM NUMBERS INDICATED WITH A HEXAGON (⬡) REFLECT ITEMS WHICH ARE PLOTTED HEREON:

A TAXES.

B THE HEREIN DESCRIBED PROPERTY LIES WITHIN THE BOUNDARIES OF A MELLO-ROOS COMMUNITY FACILITIES DISTRICT (CFD).

C THE LIEN OF SUPPLEMENTAL OR ESCAPED ASSESSMENTS OF PROPERTY TAXES, IF ANY.

1 WATER RIGHTS, CLAIMS OR TITLE TO WATER, WHETHER OR NOT DISCLOSED BY THE PUBLIC RECORDS.

2 AN EASEMENT FOR ROAD, INGRESS AND EGRESS PURPOSES AS RESERVED IN THE GRANT DEED RECORDED APRIL 30, 1928, IN BOOK 153 PAGE 320, OFFICIAL RECORDS (EASEMENT NOT LOCATABLE FROM RECORD).

⟨3⟩ AN EASEMENT FOR PUBLIC UTILITY PURPOSES IN FAVOR OF SOUTHERN CALIFORNIA EDISON COMPANY RECORDED FEBRUARY 19, 1958, IN BOOK 4201 PAGE 456, OFFICIAL RECORDS.

4 AN EASEMENT FOR PUMPING STATION AND DISTRIBUTION SYSTEM PURPOSES IN FAVOR OF LOS ALISOS WATER DISTRICT RECORDED NOVEMBER 5, 1963, IN BOOK 6792, PAGE 419, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

5 EXCEPTIONS AND RESERVATIONS IN THE GRANT OF EASEMENT RECORDED NOVEMBER 5, 1963, IN BOOK 6792, PAGE 419, OFFICIAL RECORDS.

⟨6⟩ AN EASEMENT FOR PUBLIC UTILITY PURPOSES IN FAVOR OF SOUTHERN CALIFORNIA EDISON COMPANY RECORDED MAY 20, 1982, AS INSTRUMENT NO. 82-174560, OFFICIAL RECORDS, AND RE-RECORDED MAY 20, 1981, AS INSTRUMENT NO. 82-423781, OFFICIAL RECORDS.

7 AN EASEMENT FOR WATER AND SEWAGE PURPOSES IN FAVOR OF LOS ALISOS WATER DISTRICT RECORDED JUNE 24, 1982, AS INSTRUMENT NO. 82-217506, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

8 AN EASEMENT FOR WATER AND SEWAGE PURPOSES IN FAVOR OF LOS ALISOS WATER DISTRICT RECORDED JULY 7, 1982, AS INSTRUMENT NO. 82-234280, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

9 AN EASEMENT FOR INGRESS AND EGRESS AND UTILITY PURPOSES IN FAVOR OF GEORGE SALATA AND LINDA LEE SALATA RECORDED AUGUST 9, 1982, AS INSTRUMENT NO. 82-275009, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

⟨10⟩ AN EASEMENT FOR INGRESS AND EGRESS AND UTILITY PURPOSES IN FAVOR OF MICHAEL E. BROOKS AND DONNA V. BROOKS RECORDED SEPTEMBER 13, 1982, AS INSTRUMENT NO. 82-320345, OFFICIAL RECORDS.

⟨11⟩ AN EASEMENT FOR PUBLIC UTILITY PURPOSES IN FAVOR OF THE PACIFIC TELEPHONE AND TELEGRAPH COMPANY RECORDED OCTOBER 7, 1982, AS INSTRUMENT NO. 82-352902, OFFICIAL RECORDS.

12 AN EASEMENT FOR INGRESS AND EGRESS AND UTILITY PURPOSES IN FAVOR OF JAMES E. JOHNSON RECORDED NOVEMBER 24, 1982, AS INSTRUMENT NO. 82-414655, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

13 AN EASEMENT FOR INGRESS AND EGRESS AND UTILITY PURPOSES IN FAVOR OF DONALD G. HESS AND JANICE C. HESS RECORDED MARCH 9, 1983, AS INSTRUMENT NO. 83-102136, OFFICIAL RECORDS (DOES NOT AFFECT SUBJECT FEE PROPERTY).

⟨14⟩ AN EASEMENT FOR SEWER PURPOSES IN FAVOR OF LOS ALISOS WATER DISTRICT RECORDED JUNE 25, 1987, AS INSTRUMENT NO. 87-36172, OFFICIAL RECORDS.

⟨15⟩ AN EASEMENT FOR STORM DRAIN PURPOSES DEDICATED TO THE COUNTY OF ORANGE ON PARCEL MAP NO. 86-133, P.M.B. 225/7-13.

⟨16⟩ AN EASEMENT FOR RECREATION RIDING AND HIKING TRAIL PURPOSES DEDICATED TO AND NOT ACCEPTED BY THE COUNTY OF ORANGE ON PARCEL MAP NO. 86-133, P.M.B. 225/7-13.

⟨17⟩ AN EASEMENT FOR STORM DRAIN PURPOSES DEDICATED TO THE COUNTY OF ORANGE ON PARCEL MAP NO. 86-133, P.M.B. 225/7-13.

18 AN EASEMENT FOR AVIGATION PURPOSES DEDICATED TO THE COUNTY OF ORANGE ON PARCEL MAP NO. 86-133, P.M.B. 225/7-13 (EASEMENT IS BLANKET IN NATURE).

⟨19⟩ AN EASEMENT FOR FLOOD PLAIN PURPOSES DEDICATED TO THE ORANGE COUNTY FLOOD CONTROL DISTRICT ON PARCEL MAP NO. 86-133, P.M.B. 225/7-13.

20 MATTERS CONTAINED IN THE DOCUMENT ENTITLED "AGREEMENT FOR DRAINAGE ENCUMBRANCE" RECORDED MARCH 31, 1988, AS INSTRUMENT NO. 88-149591, OFFICIAL RECORDS (CONTAINS AN AGREEMENT TO ACCEPT SURFACE DRAINAGE).

21 COVENANTS, CONDITIONS, RESTRICTIONS AND EASEMENTS PER DOCUMENT RECORDED JANUARY 19, 1989, AS INSTRUMENT NO. 89-033395, OFFICIAL RECORDS AND MODIFIED BY DOCUMENT RECORDED JANUARY 19, 1989, AS INSTRUMENT NO. 89-033395, OFFICIAL RECORDS (DOCUMENT CONTAINS EASEMENTS FOR INGRESS, EGRESS, CONSTRUCTION AND MAINTENANCE PURPOSES, EASEMENTS ARE BLANKET IN NATURE).

22 AN EASEMENT FOR INGRESS, EGRESS, CONSTRUCTION AND MAINTENANCE PURPOSES IN FAVOR OF DIMENSION BUSINESS PARK ASSOCIATION, RECORDED JULY 19, 1994, AS INSTRUMENT NO. 94-0448986, OFFICIAL RECORDS (EASEMENTS ARE BLANKET IN NATURE).

TITLE REPORT INFORMATION (CONTINUED)

23 STANDARD TITLE COMPANY NOTE.

⟨24⟩ ITEM IS IDENTICAL TO ITEM NO. 2 ABOVE.

25 STANDARD TITLE COMPANY NOTE.

26 THE RIGHT TO BORE AND SINK WELLS ON THIS, AND OTHER LAND, AND EASEMENTS FOR PIPE LINES, CONDUITS, DITCHES AND OTHER INCIDENTAL PURPOSES, TOGETHER WITH THE RIGHT TO BORE AND SINK WELLS IN CONNECTION WITH SAID WELLS, AS RESERVED.

27 A RIGHT OF WAY TO A WELL AND PUMPING PLANT RESERVED IN GRANT DEED RECORDED JULY 25, 1934, IN BOOK 690, PAGE 313, OFFICIAL RECORDS (RIGHT OF WAY NOT LOCATABLE FROM RECORD).

28 EASEMENTS AND RIGHTS OF WAY FOR ROAD AND PUBLIC UTILITIES, AND APPURTENANCES THERETO, AS RESERVED AND CONVEYED BY VARIOUS DEEDS OF RECORD.

⟨29⟩ ITEM IS IDENTICAL TO ITEM NO. 6 ABOVE.

30 ITEM IS IDENTICAL TO ITEM NO. 7 ABOVE.

31 ITEM IS IDENTICAL TO ITEM NO. 8 ABOVE.

32 ITEM IS IDENTICAL TO ITEM NO. 9 ABOVE.

33 ITEM IS IDENTICAL TO ITEM NO. 9 ABOVE.

⟨34⟩ ITEM IS IDENTICAL TO ITEM NO. 11 ABOVE.

35 ITEM IS IDENTICAL TO ITEM NO. 12 ABOVE.

⟨36⟩ ITEM IS IDENTICAL TO ITEM NO. 10 ABOVE.

37 AN EASEMENT FOR DRAINAGE AND RIDING AND HIKING TRAIL PURPOSES RESERVED IN THE GRANT DEED RECORDED MARCH 9, 1983, AS INSTRUMENT NO. 83-102135, OFFICIAL RECORDS (DRAINAGE EASEMENT IS NOT LOCATABLE FROM RECORD; RIDING AND HIKING TRAIL EASEMENT IS BLANKET IN NATURE).

38 STANDARD TITLE COMPANY NOTE.

39 ITEM IS IDENTICAL TO ITEM NO. 13 ABOVE.

40 DISCREPANCIES, CONFLICTS IN BOUNDARY LINES, SHORTAGE IN AREA, ENCROACHMENTS, OR ANY OTHER MATTERS SHOWN ON RECORD OF SURVEY 86-1057, R.S.B. 113/48-49.

41 STANDARD TITLE COMPANY NOTE.

42 ITEM IS IDENTICAL TO ITEM NO. 2 ABOVE.

43 ITEM IS IDENTICAL TO ITEM NO. 2 ABOVE.

44 ITEM IS IDENTICAL TO ITEM NO. 2 ABOVE.

45 THE AFFECT OF A WAIVER.

46 ITEM IS IDENTICAL TO ITEM NO. 27 ABOVE.

47 A RIGHT OF WAY TO A WELL AND PUMPING PLANT RESERVED IN GRANT DEED RECORDED JANUARY 4, 1951, IN BOOK 2124, PAGE 240, OFFICIAL RECORDS (RIGHT OF WAY NOT LOCATABLE FROM RECORD).

48 AN EASEMENT FOR PUBLIC UTILITY PURPOSES IN FAVOR OF SOUTHERN CALIFORNIA EDISON COMPANY RECORDED SEPTEMBER 26, 1951, IN BOOK 2234 PAGE 520, OFFICIAL RECORDS (EASEMENT IS NOT LOCATABLE FROM RECORD).

49 ITEM IS IDENTICAL TO ITEM NO. 40 ABOVE.

50 A DEED OF TRUST.

51 ANY EASEMENTS NOT DISCLOSED BY THE PUBLIC RECORDS AS TO MATTERS AFFECTING TITLE TO REAL PROPERTY, WHETHER OR NOT SAID EASEMENTS ARE VISIBLE AND APPARENT.

52 MATTERS WHICH MAY BE DISCLOSED BY AN INSPECTION AND/OR BY A CORRECT ALTA/NSPS LAND TITLE SURVEY OF SAID LAND, AND/OR BY INQUIRY OF THE PARTIES IN POSSESSION THEREOF.

53 ANY RIGHTS OF THE PARTIES IN POSSESSION OF A PORTION OF, OR ALL OF, SAID LAND, WHICH RIGHTS ARE NOT DISCLOSED BY THE PUBLIC RECORDS.

54 AN EASEMENT FOR SCENIC PRESERVATION AND OPEN SPACE DEDICATED TO THE COUNTY OF ORANGE ON PARCEL MAP NO. 86-133, P.M.B. 225/7-13 (EASEMENT IS BLANKET IN NATURE OVER PARCEL 1 OF THE LEGAL DESCRIPTION).

AN EASEMENT FOR FLOOD PLAIN PURPOSES DEDICATED TO THE ORANGE COUNTY FLOOD CONTROL DISTRICT ON PARCEL MAP NO. 86-133, P.M.B. 225/7-13 (SHOWN HEREON AS ITEM NO. 19).

NOTES

1. BASIS OF BEARINGS: BEARINGS SHOWN HEREON ARE BASED ON THE CENTERLINE OF LINEAR LANE BEING NORTH 22°19'33" EAST ON PARCEL MAP NO. 86-133, P.M.B. 225/7-13.
2. ASSESSOR'S PARCEL NO. = 610-301-07, 610-301-20, & 610-301-21 (ASSESSOR'S PARCEL NUMBERS SHOWN HEREON ARE PER THE CURRENT TAX ASSESSOR'S ROLLS AS PROVIDED BY FIDELITY NATIONAL TITLE INSURANCE COMPANY.
3. AERIAL PHOTOGRAPHY WAS COMPILED BY ROBERT J. LUNG & ASSOCIATES, DATED FEBRUARY 8, 2019, AND COMPLIES WITH NATIONAL MAPPING ACCURACY STANDARDS.
4. PARCEL B OF PARCEL 3 OF THE LEGAL DESCRIPTION IS AN APPURTENANT EASEMENT THAT, AS DESCRIBED, RUNS THROUGH AN EXISTING CONDOMINIUM COMPLEX.
5. BOUNDARY INFORMATION SHOWN HEREON WAS COMPILED FROM RECORD DATA AND DOES NOT REPRESENT A FIELD SURVEY.

DIG ALERT
DIAL TOLL FREE
1-800-227-2600
AT LEAST TWO DAYS BEFORE YOU DIG
UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

CLIENT
Great Scott Tree Care
20865 Canada Road Lake Forest

PROJECT NAME

PROJECT NUMBER
R308444.01

BUILDER

DESIGN CONSULTANT
HUITT-ZOLLARS
Huitt-Zollars, Inc. Irvine
2603 Main Street, Suite 400
Irvine, California 92614
Phone (949) 988-5815 Fax (949) 988-5820

REGISTRATION STAMP
PROFESSIONAL LAND SURVEYOR
RUSSELL H. HANSON
NO. 8873
STATE OF CALIFORNIA

AGENCY APPROVAL
DIVISION OF THE STATE ARCHITECT
APPL #
FILE #
AC FLS
SSS DATE
IDENTIFICATION STAMP

ISSUE

MARK	DATE	DESCRIPTION
1		REVISED TO REFLECT AMENDED TITLE COMMITMENT ADDED ESMT ITEM NO.

DESIGNER PROJ. NO. R308444.01
DRAWN BY:
CHECKED BY:
SCALE:

KEY PLAN

SHEET TITLE
ENCUMBRANCE MAP
GREAT SCOTT PROPERTY

SHEET NUMBER
C2.0

03/31/21

Q:\R308444.01 - 20865 Canada Road Lake Forest Engr\10 CADD & BIM\10.15 Mapping\Dwg\EM\R308444.01EM01.dwg
4/28/21 DMACKEY
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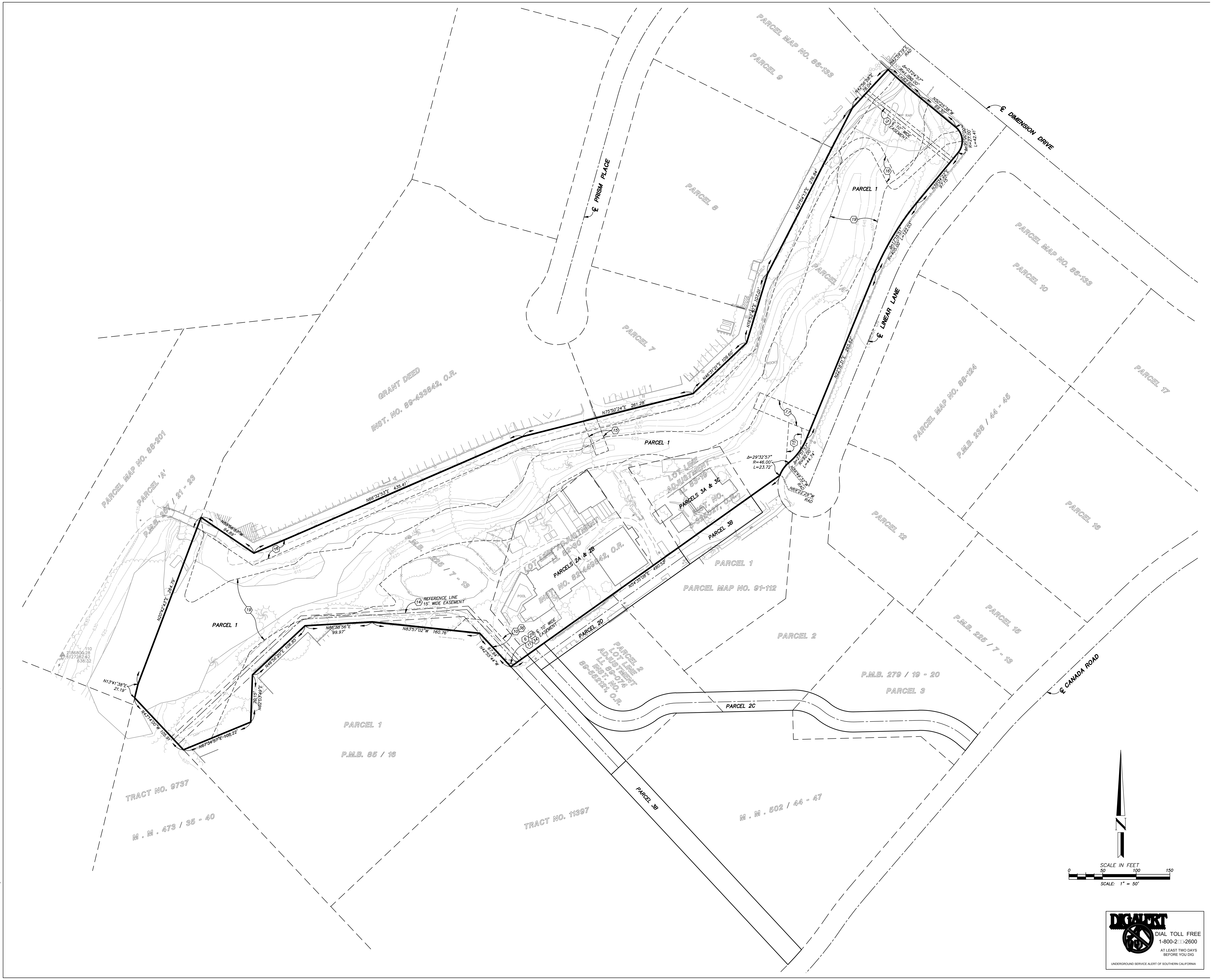

CLIENT

Great Scott Tree Care

20865 Canada Road Lake Forest

PR□□ECT NAME

PR□□ECT N□MBER

R308444.01

B□ILDER

DESIGN C□NS□LTANT

HUITT-ZOLLARS
Huitt-Zollars, Inc. Irvine
2603 Main Street, Suite 400
Irvine, California 92614
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MAR□	DATE	DESCRIPTI□N

DESIGNER PR□□. N□. R308444.01
DRAWN BY:
CHEC□ED BY:
SCALE:

□EY PLAN

SHEET TITLE

ENCUMBRANCE MAP
GREAT SCOTT
PROPERTY

SHEET N□MBER

C2.1

03/31/21

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